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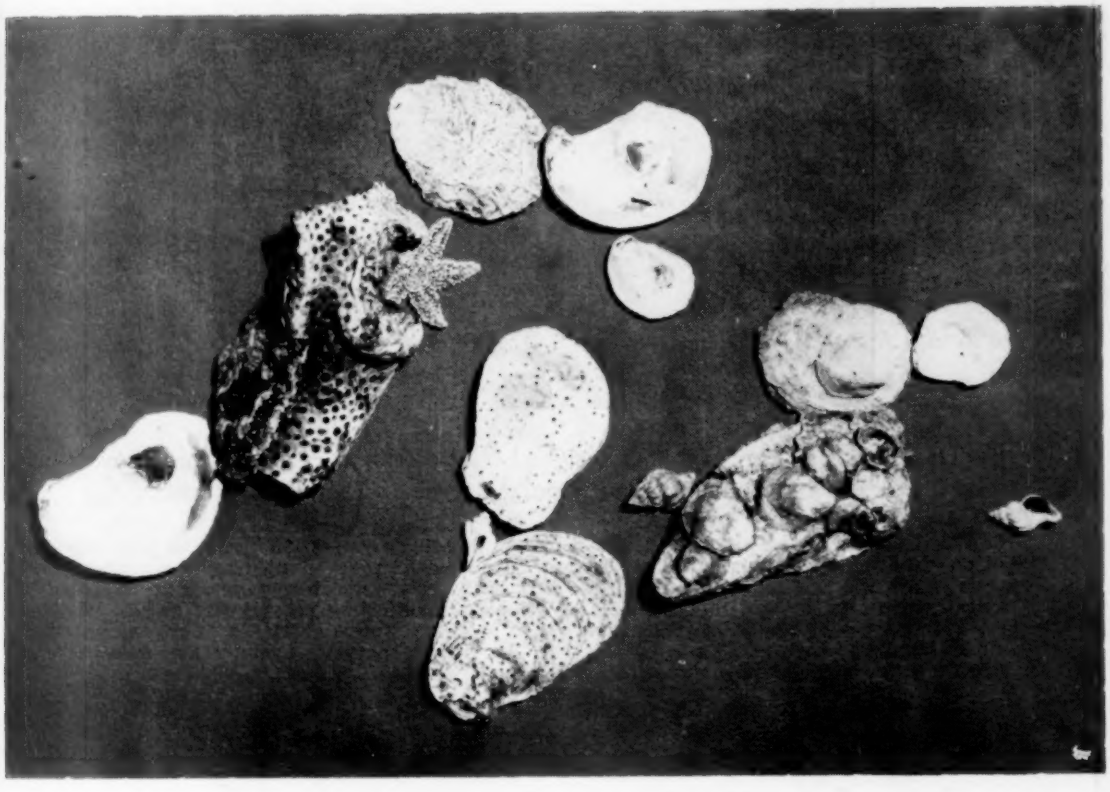

The Block of Time Idea

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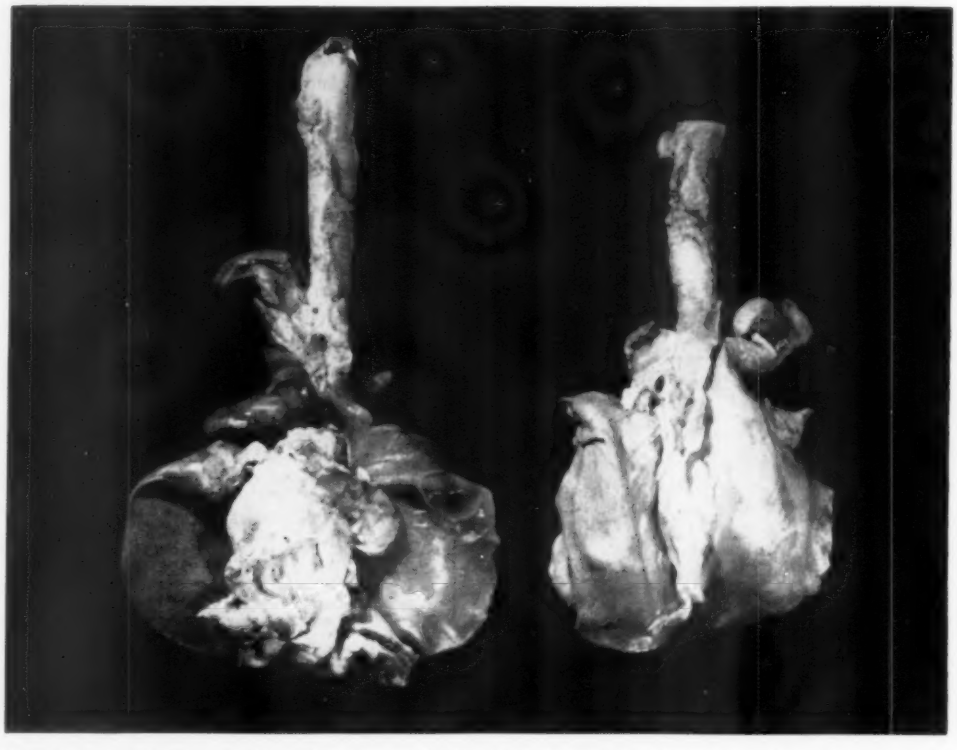
Cover Photo

Joseph L. Parkhurst, Jr., has prepared this oyster bed to include a piece of *Cliona* (next to the starfish) and two oyster shells bored into by this sponge. An article on *Cliona* is carried on page 166 of this issue. Photo courtesy of Schreiber, Linden, New Jersey.

Better Preserved Material Is Now Available for Lung and Heart Studies



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The Block of Time Idea in Biology Laboratory Instruction

ADDISON E. LEE
University of Texas, Austin

The "block" idea in biology laboratory instruction was first suggested to the Committee on Innovation in Laboratory Instruction[1] of the AIBS's Biological Sciences Curriculum Study by Dr. Bentley Glass of Johns Hopkins University. Dr. Glass is a member of the laboratory committee as well as being chairman of the Steering Committee of the BSCS. In discussing the general approach to the curriculum study and the specific approach to laboratory experiences, Dr. Glass has said:

> "The present trend of our thinking is away from a stereotyped catalog of known biological facts grouped within conventional areas. Instead, it is toward a reorganization of current biological knowledge on the basis of general themes and major threads that run through all our current biological knowledge. . . . .
>
> "The Committee on Innovation in Laboratory Instruction has commenced with a radical departure from conventional thinking and practice. . . . . An examination of the true function of laboratory work for the student. Why was it initiated in the first place? Is laboratory work necessary for a student to obtain a good grasp of biological concepts and principles, and the observations on which they are based? If not, why perpetuate the tradition which is so expensive in instructional costs and teaching time? If so, just what do the students who have studied biology without advantage of the laboratory lack in understanding? . . . .
>
> "There seem to be two conceivable functions of laboratory work. The first function was probably the principal one in the mind of Thomas Huxley and Louis Aggasiz when they introduced it in biology. Their truth was a simple one: seeing is believing. One appeals not to the authority of a living person or a book; one looks squarely at the facts, the infinitely varied phenomena of nature. Thus, the first function of laboratory work is to present the evidence from nature to illustrate the basis of our biological concepts.
>
> "The second function of work in the laboratory is to convey something of the nature of science, of its methods, and the spirit that pervades it. . . . . It is in the laboratory that the work of science is done; that the difference between science and magic on the one hand, and science and authoritative teaching on the other, is clearly perceived at first hand. If our student with no laboratory experience lacks something, surely this is it.
>
> "Today photography, amplified by motion picture and television techniques has developed to a point where it may be seriously questioned whether the *illustrative function* of laboratory work remains essential. To learn techniques that are never again useful just in order to see what may be seen without them seems wasteful if not futile. It is little wonder that our laboratory exercises have degenerated so rapidly in past decades that they can be termed nothing more complimentary than 'cookbookery.' To follow a recipe to a foreknown end, barring bungling, is at least better than labeling the names of structures on a blank drawing or spending 'laboratory time' searching the textbook for answers to questions. The illustrative function of laboratory work may well be fulfilled by good audio-visual aids, well-planned demonstrations, and an open laboratory where students can examine the objects under discussion for themselves.
>
> "For the other function something entirely different is needed, and at the present time we have no certain knowledge of how long a period of work is needed to achieve this aim. It does seem clear that we should forego the effort to parallel lectures and class discussion by formal laboratory exercises on every aspect of the course. The scientist himself is not troubled if he knows how to use a microscope, but not a spectrophotometer. He is confident that if he needs to use the latter instrument in his work he can acquire the necessary knowledge and skill.

[1]Members of the Committee are: Dr. Addison E. Lee, University of Texas, Chairman; Dr. Bentley Glass, Johns Hopkins University; Mr. Harper Follansbee, Phillips Academy, Andover, Mass.; Dr. Alfred S. Sussman, University of Michigan; Dr. Florence Moog, Washington University, St. Louis; Dr. Glenn Richards, University of Minnesota; Dr. William Jacobs, Princeton University.

"From such reasoning we are arriving at a concept of laboratory experience organized into 'blocks,' each of a few weeks' duration, and each dealing with the investigation of a specific biological problem; . . . . What is envisaged is definitely not individual project work such as students prepare for science fairs, but rather these 'blocks' are to be planned group study with standard-size classes. One might begin with an adaptation of the historical approach—the case history study advocated by James Conant. A few classic experiments could be performed to disclose the perimeters of the problem and to acquaint the students with the basic techniques necessary for their experimental attack on this particular problem. Time must be spent to teach the need for careful quantitative observations and for accurate perceptions of relationships of form to function. Applications of inductive and deductive reasoning to the problem will be quite as important as the development of needed skills of manipulation. The control of the experimenter over all variables but that one, the effect of which is to be appraised, will be demonstrated in practice. Eventually, the students will arrive at the frontiers of knowledge, at least in regard to some particulars, and will begin to develop their own hypotheses and plan experiments to test them. Each student receiving this training will participate in the thrill of the scientific revolution that is re-shaping modern life, will be able to distinguish between science and superstition, and as a citizen will be prepared to act intelligently in the thousand ways in which the scientific attitude is needed."[2]

Specific "blocks" of laboratory work suggested or in the process of preparation by various members of the laboratory committee and consultants are as follows:

1. Regulation and homeostasis
2. Interdependence of structure and function-motion
3. Regulation in plants
4. Growth and nutrition
5. Coordination and behavior
6. Animal growth and development
7. Plant growth and development
8. Uptake and transport in plants
9. Energy relations
10. Dynamic ecology
11. Genetic continuity
12. Evolution

[2]These remarks were made by Dr. Glass at the Annual Meeting of the AIBS in University Park, Pennsylvania, August, 1959.

The Committee on Innovation in Laboratory Instruction is well aware of current problems in biology instruction—limitations of laboratories and equipment, limitations of teachers' and students' time, and sometimes the lack of knowledge and appreciation of the experimental approach characteristic of many biology teachers today.

From the standpoint of operation, it is expected that each "block" of laboratory material will cover approximately 6 weeks of class time, based on the average of 5 periods, approximately 50 minutes each, per week. It is visualized that this "block" of material will replace the regular class work during the 6 weeks of its duration. This means that the remaining 30 weeks of course work should cover what is presently covered in 36 weeks. It is felt that by better organization and the use of modern teaching methods this can be accomplished with no real loss of biology content. We believe that the real participation in scientific investigation which will characterize the "block" idea will give the student an understanding of the nature of scientific methods and a stimulus for further investigation, as well as enable him to learn certain facts and techniques, to such an extent that it is well worth course time for 6 out of 36 weeks of the year.

General chemistry courses have traditionally had a section at the end of the course in which the students were given unknowns to determine. The "block" idea which we are suggesting is in some ways similar. It may involve unknown answers to questions, but it goes much further than the determination of unknowns. As we have already emphasized it will involve a series of activities from which the student can tie together answers and ideas which well enable him to develop for himself some of the fundamental principles of biology.

By concentrating much of the laboratory work, but not necessarily all, into a given block of time, it is felt that equipment and space problems will be no greater than those of any school which will offer a really upgraded biology course in the traditional manner. There is no denying, however, that the program we are proposing will involve more equipment and space than that characteristic of some high school courses today. We think that this is as it should be. If we do not offer a better and more effective program than now

Figure 1.

exists in many schools, there is no justification for the extensive study which we are undertaking.

In order to solve some of the current problems, Dr. Zachariah Subarsky of the Bronx High School of Science, New York, a consultant for the committee, has provided the committee with some examples of (1) the school-home laboratory idea and (2) a school-directed home laboratory activity. As the titles suggest, these activities permit the student to share his time and space at home with that of the school laboratory in some specific investigations. Time does not permit further elaboration of these ideas here; however, we believe that they may offer some important contributions in either the block laboratory approach or the more classical approach in the teaching of biology.

It has been suggested that the type of program we are developing will be advantageous only for the very capable student. Again, it is true that we are trying to upgrade biology teaching. However, the blocks of laboratory work will begin with simple questions and experiments—sometimes even a repetition of a classical experiment—and proceed to more sophisticated experimental approaches. The more complex activities of each block are open-ended. Such an arrangement offers something for the mediocre student who cannot go beyond the simple experiments, but at the same time will offer a challenge for the bright student who can carry the open-ended experiments further than that described in the laboratory procedure.

In order to test exercises which have been prepared by members of the Committee or consultants for the project, and in order to develop the necessary new materials and equipment for carrying out various laboratory activities, the BSCS has set up a laboratory at The University of Texas in Austin where two project associates, former high school teachers from Michigan and Minnesota, Mr. James R. Dawson and Mr. Richard E. Barthelemy, are carrying out this phase of the committee's program. These men are actually doing the activities in each "block" of material developed. They will then prepare a complete report which will include an evaluation of the practicality of the experiments, specific data on the time taken to prepare for the activities, the duration of time necessary to carry them out, and samples of data obtained during the course of the experiments. In addition, the project associates are developing new materials and equipment or modifying existing materials and equipment when it seems to be indicated for the success of the "block." They have kept in mind the necessity for low cost equipment, although in no case is equipment suggested which will not accomplish the job successfully just because it is inexpensive.

The illustrations constitute some examples of the progress of the committee and project associates on some aspects of the program during the first six months of their work.

One "block" of laboratory activities deals with genetic continuity. One of the early activities involves a repetition by the students of the classical experiment of Pasteur. This can be done using test tubes, rubber stoppers, and glass tubing. (Figure 1) The objective of the experiment is not to verify Pasteur's work but to provide students with experience in drawing conclusions from an activity which involves the use of controls and variables.

Figure 2.

Many of the laboratory activities designed to help the student understand genetic continuity involves experiments using fruit flies. (Figure 2) Small individual creamers obtained from a restaurant supply house make ideal breeding chambers for pair matings. A polyethylene squeeze bottle of the type used to dispense mustard or catsup makes a very satisfactory etherizer.

Plants are required for many different experiments. One of the problems associated with growing plants is the necessity of maintaining suitable temperature controls. The portable greenhouse shown in Figure 3 has been constructed of a heavy wire frame placed on top of a standard greenhouse flat. The wire frame has been covered with a polyethylene sheet. Temperature control can be maintained through the use of a brooder thermostat shown in front of the greenhouse in this slide. This thermostat will operate with an electric light bulb or a heating tape. A temperature range from 4° Centigrate to 40° Centigrate has been maintained in the portable greenhouse with an outside temperature of 4° Centigrade.

Yeast and bacteria cultures are also used for many experiments. Figure 4 shows a temperature control box made of camping oven and the same brooder thermostat shown in the previous slide which can be used with a light bulb or heating tape. The oven is designed for use where the temperature must be higher than the outside temperature.

In some localities there is a need for a constant temperature which is lower than that of the room. Figure 5 shows an old refrigerator (a gift from a local merchant) which was modified by the addition of an insulating shelf (corrugated cardboard) and the brooder

Figure 3.

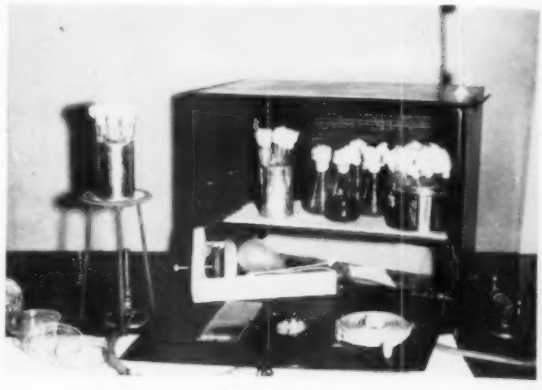

Figure 4.

thermostat controlling the temperature of the lower chamber of the box. The temperatures maintained are minus 11° C in the freezing compartment, 4° C on the top shelf, and 15° C on the bottom shelf. The circular item in the bottom chamber is an agitator for cultures in liquid medium. It is made from a phono-

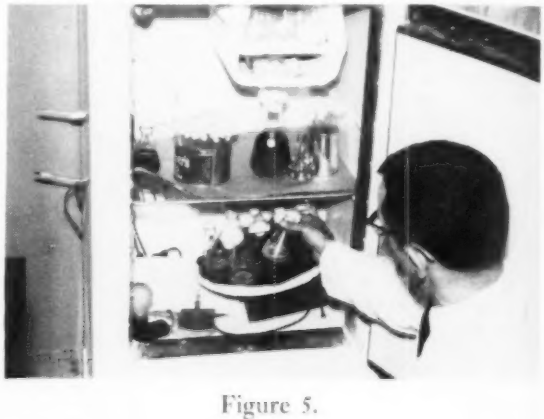

Figure 5.

graph turntable slanted at an angle of 10° and turning at 33.3 RPM.

Figure 6 shows a number of pieces of low cost equipment for use in culturing various organisms. It includes the oven and agitator as well as a large size pressure cooker which we use as an autoclave for sterilizing media and glassware. Note also the effective use of coffee cans and fruit juice cans as holders for test tubes and petri dishes.

Another "block" of laboratory activities deals with the interdependence of structure and function-motion. In this series, it is necessary, among other things, to study live frog muscles under experimental conditions. Figure 7 shows a kymograph made of a 2 pound coffee can turned by a slow speed motor

Figure 6.

using a rubber band as a drive belt. The stimulator is made from the materials available at a television repair shop. It operates on either a battery or alternating current. Intensity of the impulse is adjusted from 0 to maximum input voltage. Duration of the stimulus is .0015 seconds. The lever arm is made from a swab stick with a piece of photographic film as a scriber. The hinge and pan are made from .3 mm. aluminum such as is used in some frozen containers.

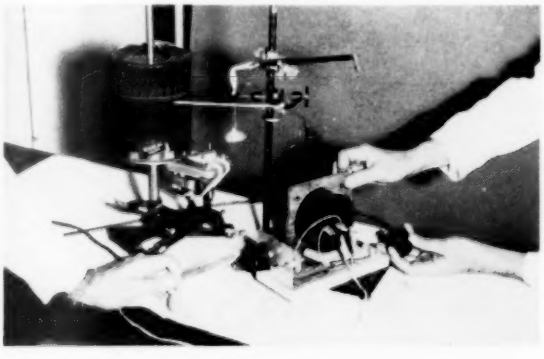

Figure 7.

Figure 8 shows a simple design of an evaporator which will lift a column of mercury 66 centimeters. It was devised from 2 small flowerpots cemented together with epoxi. It is an example of a piece of equipment constructed from inexpensive pieces which will accomplish the same purpose as a more expensive piece of equipment.

The use of inexpensive equipment such as we have developed will not only aid the introduction of the experimental approach in the teaching of biology but will also permit teachers to provide enough equipment for more individual student work.

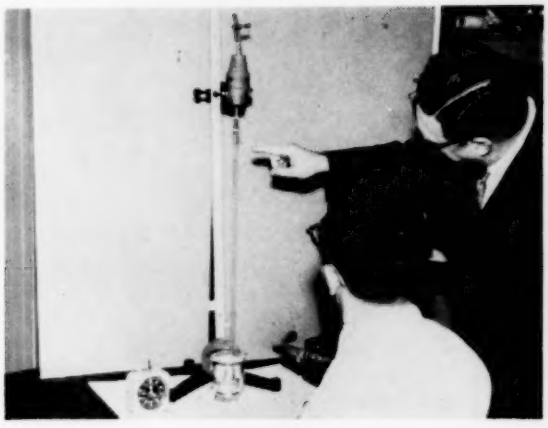

Figure 8.

This will permit experiments by individual students in many instances where previously a demonstration was the most that could be provided.

Last spring the President's Science Advisory Committee issued a report "Education for the Age of Science." It stated:

> "In a frontier society, such as that of America of 100 years ago, it was natural that physical prowess and bravery, inherent in the pioneer, should have been held in high esteem. Today the frontier is intellectual; the scholar, the research worker, the scientist, the engineer, the teacher are the pioneers."

If we are to really earn this kind of high esteem in biology education, we must exhibit the courage and exert the effort of our pioneer forefathers to bring about the changes needed to accomplish teaching excellence in biology.

Leukemia

Leukemia is a form of cancer for which there is growing evidence that it may be caused by a virus. The American Cancer Society is now investing nearly $1,000,000 in search for a cure for leukemia. It is also supporting $1,250,000 in virus research. Research has made it possible to cure leukemia in laboratory animals by drugs and massive doses of X-rays. These experimental approaches, however, have not made it possible to cure leukemia in human patients. Support the American Cancer Society's April Crusade and help continue this encouraging research attack.

Feeding Habits of Grain Insects*

OSCAR TABOADA and HERMAN KING
Michigan State University, East Lansing

Objective:

The objective of this exercise is to learn (or to demonstrate) the difference in feeding habits of the grain weevils, as represented by the granary weevil or the rice weevil, and the "bran-bugs," as represented by the confused flour beetle. The grain weevils can feed on whole, clean kernels of wheat, while the flour beetles are limited to broken, cracked or soft kernels, or to milled products. To students of agriculture or industries associated with the handling of wheat, these facts have practical significance. In areas such as Michigan, where flour beetles are common but grain weevils occur only occasionally, careful harvesting, handling and storage help to prevent damaged kernels which might provide starting points for flour beetle infestations.

In general biology classes, the same exercise can be used to demonstrate the adaptation of snout-beetle (*Rhyncophora*) mouthparts for feeding on whole grains. In addition, observations on the metamorphosis of the Coleoptera are made as a matter of routine. Stock cultures may be left unattended throughout the summer.

Materials and Equipment:

1. Stock culture of granary weevils, *Sitophilus granarius* (L.).
2. Stock culture of flour beetles, *Tribolium confusum* Duv.

The species listed here are the ones used at Michigan State University. In other areas other representative species may be more available. Stock cultures are kept in 5-gallon lard cans with small screened openings in the top. If each can is filled one-third to one-half full of the appropriate food, the culture will maintain itself for a year without further care. It can be kept in any laboratory at ordinary room temperature, if the air does not become too dry. The relative humidity should be at least 50 percent. The cultures should be handled with some care, since they feed readily on some types of museum specimens.

3. Wide-mouth Mason jars, pint or half-pint in size.

Four jars are needed for each demonstration (or for each student). Open-center jar rings are used to hold small squares of muslin in place over the jars.

4. A supply of whole wheat.

One pint will be needed for each demonstration. It should be sorted carefully to eliminate all chaff and damaged kernels.

5. A supply of bran or whole wheat flour.

One pint will be needed for each demonstration.

6. A glass marking pencil.

Methods and Procedures:

This experiment should be set up early in the course and the observations made near the end of the course. A minimum time of seven weeks should be available. More time is desirable. Directions for procedure are as follows:

1. Fill each of two jars about 1/3 full of whole wheat kernels, carefully sorted to remove all damaged kernels.
2. Fill each of the other two jars 1/3 full of bran or whole wheat flour.
3. To one jar of wheat add 50 *Tribolium* beetles. (To transfer *Tribolium* easily, stand a 2" x 3" file card upright in the

Figure 1. Method used to count and transfer *Tribolium* beetles from the stock culture to the demonstration container.

*Departments of Natural Science and Entomology contribution No. 141.

Figure 2. Counting and handling *Sitophilus* weevils is made easier by separating them from the wheat with an eight-mesh sieve and a glass vessel. After the weevils fall through the sieve the receptacle is then held in a vertical position and the insects are brushed off into the demonstration jar. If no sieve is available the same procedure is used except that the weevils are brushed directly out of the wheat culture.

stock culture. After a number of beetles have crawled onto the card, pick the card out and brush the beetles into the demonstration jar.)

4. To one jar of flour (or bran) add 50 *Tribolium* beetles.
5. To the second jar of wheat add 50 granary weevils.
6. To the second jar of flour add 50 granary weevils.
7. Cover each jar with a piece of muslin and fasten it in place with the jar ring.
8. Label each jar with a number and the date.
9. Store all jars at room temperature.

If constant temperature cabinets are available or if cool basement storage is available the demonstration can be expanded by storing duplicate sets at different temperatures. This will demonstrate the effect of temperature on arthropod metabolism, as well as the practical value of cooling grain before storage. Very dry atmospheres should be avoided. The relative humidity should be at least 50 percent and 70 percent would be better.

If constant humidity can be maintained the exercise can also be expanded by using wheat of different moisture content.

Observations and Results:

After the jars have been stored long enough for a complete life cycle, quantitative observations can be made. A data sheet including the following items should be completed for each jar.

1. Jar No. .....
2. Date started .....
3. Kind of insect .....
4. Kind of food .....
5. Temperature of storage .....
6. No. of adults started .....
7. Date of final observation .....
8. No. of live adults found .....
9. Other evidences of a thriving infestation:

.....
.....

Report and Discussion:

Comparison of the data sheets will indicate that granary weevils are better adapted to feeding in whole wheat and that flour beetles are better adapted to ground wheat. Questions such as the following may be discussed either verbally or in written reports.

1. What is the difference in the life histories of these two insects; i.e., where is each stage found?

Figure 3. Interior view of an incubator displaying different types of containers used for rearing grain insects. Enamel pan at bottom contains a water-commercial salt solution made up as a slushy mixture to produce a relative humidity of around 70% at 80° F.

2. What modification enables the granary weevil to attack whole kernels so successfully? (Sketches of the mouthparts and of the larvae may be helpful.)
3. Show how these insects might be associated as primary and secondary pests of stored grain.
4. Discuss the relationship of careful harvesting and cleaning of wheat to the stored-wheat insect problem, especially in areas where weevils are scarce and flour beetles are common.
5. What is the significance of poikilothermy in the practice of cooling grain by power blowers?
6. How does moisture content affect the infestation of wheat by insects?

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Two Starch Digestion Experiments Using Agar Plates

DAVID KRAUS, *Far Rockaway High School, New York*
and
EUGENE I. STERN, *George Washington High School, New York*

Experiment 1. To demonstrate that saliva digests starch.[1]

Many teachers perform a controlled experiment in test tubes to demonstrate that saliva digests starch to reducing sugar. Here is a quick, interesting, and dramatic variation that can be used in a review lesson on the following day.

1. Prepare, in advance, unsterilized starch-agar plates consisting of 1% boiled soluble starch and 1% agar.
2. Using a finger, or a cotton applicator, draw a big "X" on the surface of the agar.
3. After two minutes, flood the plate briefly with dilute iodine solution and then pour off the excess. The iodine-starch complex is blue, but the area where the starch has been digested by the saliva is practically colorless.

Observation. When held to the light, the letter stands out as a clear area against a blue background.

A challenge. "This demonstration merely indicates the disappearance of the starch. Can you *prove* that the starch is changed to *sugar?*" For homework have interested students write a suggested procedure to answer this question. Let them try out their recommendations in class. If class time is short, pupils can be loaned materials for home experimentation. Clinitest tablets, test-tape, or clinistix are convenient sugar-testing agents for the home experimenter, but the latter two are specific for glucose.

Experiment 2. To demonstrate that bacteria digest starch.[2]

1. Prepare a sterile starch-mineral agar plate (see Difco manual).
2. Streak the school's initials on the plate with *Pseudomonas saccharophila.*
3. Incubate overnight.
4. Flood the plate with iodine solution and pour off excess.

Observation. The letters stand out as clear areas against a blue background.

If the plate is inoculated a day in advance, both demonstrations can be performed at the same time. Performed as a unity, they yield the serendipid inference that man and microbe share certain functions.

[1] From a suggestion by Dr. Seymour H. Hutner of the Haskins Laboratories, New York City.

[2] Modified from Stanier, R.Y., Douderoff, M., and Adelberg, E.A.: *The Microbial World*, Prentice Hall, 1957, p. 153.

The Classroom as a Wedge in Removing Fear of Our Common Snakes

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A surprisingly large number of persons in our society either cannot, or will not, accept the truth about one of our most useful forms of animal life—our harmless common snakes. This unfortunate attitude exists because it seems to be a characteristic of human beings to avoid learning any good about something which they prefer to consider as harmful. They refuse to learn how to tell the harmless from the poisonous ones.

Many people still believe that a hair from a horse's tail, if placed in water, will turn into a snake. The milk snake gets its name because it is found around barns, the assumption being that it sucks milk from the cows. Likewise, the so-called "hoop snake" which supposedly takes its tail in its mouth and rolls along the road according to legend, is a perfectly harmless and attractive specimen which, like all other snakes, cannot possibly travel in such a manner. The fact that is hard to understand, is, that people, normally intelligent in most of their thinking, will lean heavily upon the myths passed down through the centuries. It is because of the misconceptions surrounding the common harmless snakes that there appears to be a great need for education in this area.

The belief that a snake has a slimy skin can only come from hearsay, never from actual experience. The fact is that the snake's skin is not slimy, but quite dry, pleasantly firm to the touch and in many cases very beautiful. The mother snake that swallows her young when danger threatens, does not exist. That "nature in the raw is seldom mild" can be applied here. If the mother snake is seen swallowing her young, it can be correctly concluded that she has just obtained her evening meal. She is not tucking her young into bed, nor protecting them from harm. The idea may have originated from an autopsy performed on a recently killed snake in which were found the young ready to be born. Since most people believe that all snakes lay eggs, they no doubt feel that these young were swallowed rather than conclude that they were unborn.

The raising of some baby snakes or the hatching and raising of some can add much to the general biology course or general science course. There is little point in studying and learning isolated facts concerning snakes, however interesting or strange, if the student fails to get an overall picture of their usefulness and harmlessness. This project in a biology course can embrace relationships of the most compelling interest and significance. The real value of this activity lies in the undermining of age-old superstitions which are still very active today.

Common garter snakes, ribbon snakes, DeKay snakes and red-bellied snakes are livebearers. If, by careful searching, a group of newly hatched young can be found, the project is well on its way. These young placed in the properly constructed terrarium which has been previously made ready, will open a whole new vista of first-hand experience for the student.

If the newborn cannot be found, or if the instructor prefers to collect adult snakes, a few smooth scaled green snakes or ringnecks are most suitable. Each species should be placed in separate terrariums, and the collecting of several of each variety should increase the possibility of getting eggs to use in the classroom.

It is all-important to place the "egg layers" in the terrarium in which the eggs are to remain. In fact, it is a must, if the project is to succeed. As soon as some eggs are discovered, the adults should be removed and either placed in another terrarium, temporarily, for student study, or taken out into the woods and released. Otherwise, as the hatching starts, the adults will be confronted with a "choice" dinner. The harsh cold fact remains, they have no mother love and a dinner is a dinner, especially when they are confined and can-

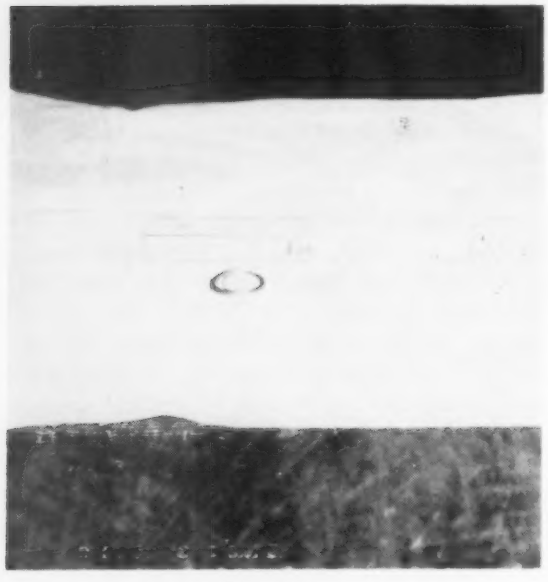

Figure 1
The newborn green snake is about four to four and one half inches long and about an eighth of an inch in diameter.

not get around and choose for themselves. The care and feeding of these adult snakes while in captivity is not a problem—knowledge concerning this can be found in many science or wild pet books.

Terrariums for the young are simple to prepare. However, contrary to some sources, the comparatively dry, sandy terrarium with screen cover seems to give the best results with the young snakes. There must be included a jar cover for water, as well as a twig or two in proportion to the area of the container; this will give the young ones a veritable playground. Several medium sized stones, not more than an inch and a half in diameter lend composition and naturalness to the "home" as well as providing a place for the young to do some tunnelling. They can work their small bodies down under these stones and appear to love to rest in the cool dark places thus provided.

Terrariums for adult egglayers require a little more care and a little different setting. Coarse sand to a depth of two inches in a twelve-gallon container can be used, then layers of moss, some small twigs from the woods on which moss and fungi are still growing, and some small green seedlings. The terrarium also should contain several larger pieces of bark under which the adult snakes could deposit their eggs. The jar for water is also needed. Food can be given according to the adult needs, a discussion of which can be found in any book on terrarium or wild pets. However, each day the area must be inspected to determine if any eggs have been laid. As mentioned before, as soon as eggs are found and it has been ascertained that laying has been completed, the adults should be removed to another terrarium.

In the hatching of the eggs, one meets the greatest challenge. It was found best to place a thermometer and a lamp inside the glass enclosure, and a glass cover over the entire top opening. It takes quite constant care and checking, at least twice daily, to keep the eggs in good condition. If they show signs of becoming wrinkled it is an indication that the atmosphere is too dry, and more water must be placed in the container and also the greenery should be sprinkled. If the eggs show any tinge of grayishness, resulting from a molding condition, then the top glass cover must be immediately removed until this condition is corrected.

When the hatching starts, the observer will notice a small crack in the top of the gelatinous appearing shell; sometime within an hour or two a small head will slowly emerge. It may take several hours before the process gets under way and the animal works his body out of the shell and starts over the moss to explore his surroundings. The bright little eyes, small slender bodies and perfectly controlled muscular movements are well worth all the work necessary to bring them into the classroom. This is a real integral part of learning about snakes in a biology course. The excitement and cultural value when viewed first hand opens a whole new relationship with these creatures and instills an awareness to their place in the scheme of the animal world that will be hard to break down.

After the eggs have hatched, the young should be carefully transferred to the dry sandy terrarium already described. The food for these newly hatched young may be a little different from that required for the live-bearers. It appears easier to get the young of the live-bearers to eat crickets, tiny sections of wiggling earthworms, grasshoppers, and spiders; however, in the case of the newly hatched babies of the egg-layers the feeding problem is more difficult. These young seem

Figure 2
For their size, these young snakes show remarkable skill in climbing. In the terrarium above the animal would climb to the top as long as he could use the glass. The small body formed a semi-suction cup against the flat surface. In the above picture the snake is almost to the top on the right-hand side.

much more temperamental and resistant to many foods. The newborn green snakes may eat tiny crickets, small spiders, and a few other insects, but they seem to prefer very small soft moths of several different species.

Now comes the time when the instructor's judgment is very important, and this decision determines the length of time the young snakes can be kept in the terrarium. By this, the implication is that these "children" like all other children can and will become spoiled and as a result will eat only what they like the best. In due time the chosen food may become scarce, and it may be too late to switch to another food that is more easily obtained.

Experience has shown that the "ideal" learning value comes from keeping the terrarium about a month, then taking it out in the woods or fields, and releasing the young snakes while there are still plenty of small insects to be found, and also sufficient time for the animal to find a home for the winter.

In summarizing this project, it is necessary to recall that an attempt is made not only to teach students the habits of these reptiles and their value to man but to help these boys and girls learn for themselves the falseness of the many and varied misconceptions regarding snakes.

Biology Films–Education or Entertainment?

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With the exception of the chalkboard, films are probably used more as a teaching and learning device than any other visual aid. Conversely, films are also probably misused more than any other teaching device, with the exception of the chalkboard. There are multiple reasons for this ineffective use of the biology film. Historically, we, as teachers, have associated films with Hollywood-type entertainment. Pupils are similarily endowed with this attitude, but to a greater degree. The prevailing attitude is "Let's relax—today is movie-day." This does not presuppose a complete lack of a minute amount of concomitant learning. However, from a psychological viewpoint, entertainment seems primary and learning is secondary in this type of academic climate.

Contributing to the entertainment atmosphere are films shown that are poorly timed in the course of study or ill-placed in the sequence of subject-matter being taught. Pupils are very aware of this unrelatedness and poor timing and react accordingly.

Failure to preview a film serves to catalyze situations which are confusing and embarrassing. Films of poor speech clarity, or films narrated in unfamiliar accents have little educational value, if the effectiveness of the film depends upon the narration. The educational value of a film is dubious if the film presented is dated by the dress of the actors, the vintage of the automobiles, and obvious antique procedures and techniques in science. No matter how good the film is otherwise, the use of the vocabulary of the primary grades does not precipitate interest at the high school level. Films revealing the defects mentioned above should be rejected for they are a poor

substitute for any classroom activity no matter how remote or abstract.

Generally, a film that can be shown and reviewed in one period of class time has greater potential educational value than one of greater time consumption. A film that requires more than one class period is as disrupting and ineffective as a story without an ending. If a film cannot be used effectively, it should not be used at all.

When should a film be used in a biology class? A film should be utilized when it is impossible to devise a laboratory exercise or demonstration or any other adequate teaching device for a particular subject area. A film should support a basic need. It should be used as a substitute for verbalization, or as a preview or review of a specific topic. A good color film of the life of the Monterey Peninsula is the next thing to an actual visit to that unique and beautiful area and is a superior substitute to thousands of descriptive terms that might be used by the teacher. This is one method of bringing an inaccessible area into the classroom.

A film should also be used to develop interest, inspiration, and appreciation. What is more inspiring than a film depicting the life of Pasteur, or what could be more interesting than a well-narrated color film of the life and discoveries of Luther Burbank? Few high schools in the United States can duplicate the time-lapse microphotography found in certain excellent films in the laboratory. The time-worn phrase, "a picture is worth a thousand words" is certainly applicable in the subject area of spermatogenesis, and a teacher utilizing such a film in this difficult subject will be rewarded by an increased understanding and appreciation on the part of the student of the subject. A good film shown at the proper time and at the proper grade-level will develop interest, inspiration, understanding, and appreciation.

A check list should be of some value to a biology teacher who is attempting to evaluate a film for future class use. The check list should be simple enough that one or more negative items checked should serve to invalidate the use of the film. If all positive items are checked, then the film is acceptable for use. After the film has been shown to the pupils, the films should be re-evaluated in terms of their general response.

A CHECK LIST FOR EVALUATING BIOLOGY FILMS

I. Purpose of the film.
   - A. Preview
   - B. Review
   - C. Interest development
   - D. Inspiration
   - E. Understanding and appreciation

II. Elapsed time of the film.
   - A. Less than class period
   - B. One class period
   - C. More than class period

III. Clarity of narrator.
   - A. Clear and easily understood
   - B. Not clear and easily understood

IV. Grade level.
   - A. High School
   - B. Elementary
   - C. Primary

V. Photography
   - A. Excellent
   - B. Good
   - C. Poor

VI. Theme.
   - A. Clear and to the point
   - B. Confused

VII. General response of the pupils.
   - A. Created understanding
   - B. Developed interest
   - C. Developed appreciation
   - D. Did not develop interest, understanding, or appreciation.

Science Clubs of America New Handbook

An information packed Science Clubs of America Sponsors Handbook for 1960 is now available from Science Service, 1719 N Street, N.W., Washington 6, D. C. In addition to Science Talent Search and Science Fair information, there is a listing of free and inexpensive materials and science opportunities for students.

Half of those who get cancer in the United States could and should be saved, through early diagnosis and treatment, says the American Cancer Society. This would mean the annual saving of 250,000 lives. Support the Society's fight against this disease.

Urban Biology – An Ecological Approach

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In 1851, Philip Henry Gosse wrote, "Natural History is far too much a science of dead things: a *necrology*."[1] In the summer of 1873, Louis Agassiz said to his students: "We are, I suppose, all intelligent enough to open our eyes and look upon nature for ourselves, and we will try to make nature as it surrounds us its own textbook . . . . nothing is so well known as to leave nothing to be done about it."[2]

In 1960, and during the preceeding decade, more biologists and biology teachers are writing and speaking slightly different words which express the same idea: "Biology is the study of LIVING things, not dead ones . . . . Let's take the ecological approach to the teaching of biology."

Urbanization, increase in population density, and population shifts are increasing the urgency for ecological education. Besides, the ecological approach to biology makes more sense, it is more interesting and more fun for the beginning student.

It is a fine thing for us, the teachers, to understand ecology and what it has to offer toward solution of human problems. We have been fortunate in our education. But more and more of us find ourselves teaching in large consolidated schools and in city schools. What can we do for our students? How do we translate our noble dreams into action? The answers are not easy, but there are some answers.

There are at least four essential steps in the path from dreams to action:

1. We must think about what we hope our students will learn.
2. We must survey our school, community, and city resources.
3. We must devise ways to use these resources.
4. We, ourselves, must continue to be interested in and study living organisms. Our ability to see opportunities and to guide our students depends on the richness of our own experience.

What Do We Hope Our Students Will Learn?

If we use an ecological approach, the principles and concepts involve relationships. No organism, indeed no part of an organism, exists in isolation. Its structures and functions are significant only as they relate to other factors. Our list of "things to be learned" may include these items:

a. Relationships between structure and function.
b. Relation of life history to habitat.
c. Survival values (+, —, or 0) of structures, function, life history, behavior patterns.
d. Relationships among organisms of any given area.
e. Influences of, or limitations imposed by the environment on the organism.

We are interested also in having our students acquire certain skills: observing accurately, noting and measuring similarities and differences, keeping records, organizing data, drawing conclusions, recognizing and formulating questions arising during or as a result of observations. And, first and last, the ability to define a problem—to see a question in a situation.

We Must Survey and Inventory Our Resources

Every school and community, urban or rural, has resources. Admittedly, city teachers may have more difficulty than rural teachers finding and seeing these. Thus, this list will point up city creatures.

Animals

Pigeons, English sparrows, starlings, gulls.
Transient birds during spring migration (city parks are often heavily populated during late April and early May).
Squirrels (gray, red, or fox, depending on the part of the country).

[1]Palmer, E. L. Ed. *Nature Writings*. Cornell Rural School Leaflet. Ithaca: Cornell University, Sept., 1959. Gosse, p. 4.

[2]Ibid., p. 6.

Rats and mice
Insects: roaches (3 species), ants, flies, mosquitoes, bed bugs, fleas, lice (don't laugh—these human parasites are not as difficult to find as we wish they were), and many other insects present on city plants.
Insect relatives: spiders, etc.

Plants

Street trees, park trees.
Plants in cracks in sidewalks and between bricks.
Plants in small yards, gardens, and vacant lots.
House plants.

City Institutions

Botanical gardens
Zoos
Museums
Large wholesale markets, (produce, meat, fish), exotic imports of insects, arachnids, etc.

The reader may use this list as a guide to suggest specific resources in his own school community and city.

Ways to Use these Resources—Suggested Studies

A few study problems are described here. Others are suggested briefly. The teacher can devise many more, especially if he has had some field study experience. Many studies done in ideal locations (large forests, etc.) can be modified, broken down into small studies, and adapted to urban opportunity.

1. *City birds*

a. Locate a flock of pigeons easily observed. Perhaps you can learn to recognize a few individuals or perhaps you can mark them with colored bands.

b. Observe: Courtship, mating, nesting habits. Are these activities seasonal or continuous?

Do individual birds defend territories?

Does the same bird always occupy the same position on the roost each night? Is there any competition for roosting positions? You will probably find that there is evidence of dominance hierarchy in the flock. Observe until you work out the social organization.

What types of buildings seem to be most attractive to pigeons? How do you account for this "preference"?

c. Select an area where you can feed the pigeons at a definite time each day. Offer a variety of food scattered over a broad area (3 to 6 sq. yards). Do pigeons eat only one kind of food offered, or do they eat all kinds indiscriminately?

Select a food you are certain they will accept. Scatter it over a broad area. Diminish the area day by day until the food is offered only on one or two square feet. Note behavior changes of the birds in the group.

d. After observations have been made, try to hypothesize why these birds are so successful in densely populated human communities. Undoubtedly, the answer is to be found in their breeding and feeding habits, and in their tolerance of some physical factors of environment.

Some of these study methods can be adapted to studies of English sparrows and starlings.

Have the "city birds" driven other birds away? Perhaps they have in some communities, perhaps not. Analyze the question. Pose a series of questions about "city birds" and "country birds" which may help provide some reasonable answers to these broader questions.

2. *Other bird studies*

If you wish to study birds as an animal type, city birds are fine specimens. Note how they use wings, bills and feet. Do birds land and take off into the wind or with the wind? How do birds steer during flight? Compare birds to planes: how are lift and thrust achieved in each?

Identify migrants. Keep a bird calendar during April and May. This may be accompanied by library research to find out wintering and breeding grounds of each species observed. Questions of food, energy, endurance, and direction-finding can be considered.

3. *Roaches*

These are easily obtained and interesting to study.

a) Construct a trap and place it in a likely spot.
b) How do roaches react to various colors of light??

One investigator found that ants do not perceive red light; thus they react to it as to total darkness. Is the same true of roaches?

Von Frisch[3] found that bees do recognize some colors and can be trained to associate these colors with food. Can roaches be so trained?

Construct cages or use aquaria. Divide each cage into two or more compartments. Cover each with a different color cellophane.

c) How do roaches react to DDT?

A crude experiment can be conducted with a common aerosol bomb. Give a roach one quick blast and observe reactions over ten minutes or until the roach either recovers or dies. Give another roach two quick blasts. Compare reactions to different amounts of DDT. Compare roach reactions to those of other insects.

d) Large roaches are excellent material for study of generalized insect type. They may be used instead of grasshoppers and other common laboratory forms.

4. *Bees*

If the school is located near a park or botanical garden, an observation hive may be kept in the classroom. Most observation hives are too small for normal food storage by the bees, so the hives must be watched, and perhaps bees must be artificially fed. Care of hive is not difficult but does require attention.

5. *Demonstrate insect life histories.*

a) Roaches are good material to demonstrate gradual metamorphosis.

b) To demonstrate complete metamorphosis, expose a small piece of meat (keep it moist) in an area which flies will visit. After you are certain that eggs have been deposited, cover the container and observe contents periodically. If your town is fly-less, use the fruit fly, Drosophila, to demonstrate this type of insect development.

6. Repeat the famous Redi experiment which contributed to the proof that organisms must have parents. This involves exposing one sample of raw meat under a screen or cheese cloth and another sample uncovered. The screened sample of meat decays due to action of saprophytic bacteria. Fly eggs deposited on the screen may hatch there, but no maggots or pupae develop on the meat. Watch the uncovered sample and record results.

[3]Von Frisch, K. *Bees, Their Vision, Chemical Senses, and Language*, Ithaca: Cornell University Press, 1950.

7. *City trees*

a) Learn to recognize the common trees of your city. Although some teachers shun teaching beginners how to use keys for identification, the keys have proved helpful in at least two ways. When you identify a tree or an insect, by using a key your attention is called to interesting structures, interesting differences which you might not otherwise notice. A second and more obvious value is that of developing skill in identification. Many of the beginners you teach will become amateur and professional biologists and naturalists. Their experience with you may influence them in this direction. Your introducing them to these tools (keys) can be the start of more advanced work.

b) Compare your list of street trees to your list of park trees. Try to account for similarities and differences.

c) If ages of trees can be determined, note variety of sizes of equal age individuals growing in different habitats. (A 60-year-old oak growing on a mountain ridge had a 3-inch diameter stem. Another oak of the same age in the valley below had an 8-inch stem.) Will the tree in the vacant lot show as rapid growth as that in the park? Can you determine approximately the age of suburban development by the age of the trees in it?

d) In spring select and label a small twig. Measure, in millimeters, the length of the dormant bud. Make daily measurements as the bud swells, bursts and as the leaf develops. Measure from base of petiole to tip of leaf. Plot these measurements on a graph to show rate of growth.

Use this method to compare rate of growth of leaves of several species.

Do all trees flower before they leaf? Which species break dormancy first? During the few weeks of spring, when deciduous trees show most rapid development, observe a group of trees daily. Keep records of flowering and leafing. Keep weather records, too. Graph these data.

Ways to Use the Resources—Organizing the Class. The Whole Class Works Together

1) *A trip to the zoo.* All of the larger zoos have public relations directors or school consultants whose job it is to help you plan your

trip. One of the keys to a successful trip is to plan to see and do enough (or just a little more than there is time to do), but not too much. Decide what you want your students to see. Don't try to cover the whole zoo in one trip.

A guide can help you find answers to these questions: How do zoo curators create an artificial environment similar enough to the natural environment of the animal to meet its needs? How are problems of light, temperature, water and food met? Investigate the care of animals from many climates: dry and wet tropics, subpolar regions, mountains and lowlands.

How much and what kind of care is given to sick animals? A curator can show you the zoo hospital.

For a successful trip without a guide, prepare a guide sheet to direct students' attention to selected exhibits. Pose questions which can be answered after close observation of the animal. For example:

Watch the seals. Describe the device which prevents water entering the respiratory passages.

Observe over-all body structure (size and shape). Of what advantage is this in water? . . . on land?

How are seals' flippers different from fish fins? . . . in number? . . . in form? . . . in location? . . . in function?

Other questions can direct attention to animals of one region (African Plains) or to the diversity of structure of animals of one taxonomic group. Questions may be in terms of adaptation to certain habitats, or of survival value of certain structures or behaviors.

2) *Group study of plant-animal community.* (The plants on a vacant lot.) In one or two class periods a group of students can collect data from the site. Divide your class into several small teams about four students in each. Let each team investigate one environment factor (temperature, light, relative humidity, plant and animal life), or better, mark as many sample plots (about one square yard each) as you have teams and let each team collect data from one sample. Each team should record data on similar forms.

For example, record:

Date: Time: Location:

Number of plants:

Number of kinds of plants: (collect one sample of each kind if this is permissible at your site).

Number of animals (or signs of animals):

Number of kinds of animals (or animal signs): Identify or describe.

Temperatures: 3″ below soil level.
Soil level.
3″ above soil level.
6 ft. above soil level.

Relative humidity: (in different parts of plot).

Compile the records of each team. Devise a way to compare and represent the data to show a picture of the variations within the area. Repeat the investigation once or twice each season through the school year and obtain seasonal comparisons.

3) *Learning the trees through use of keys.* Simple leaf keys may be mimeographed. One class period is sufficient time to learn how to use the key. Select a tree which nearly everyone knows and work this specimen through the key with the whole class. That is, use a known specimen while learning to use an unfamiliar tool. Plan your short field trip so that you may key leaves of each major type (simple and compound leaves, pinnate and palmate venation, entire and serrate edges). Take students to trees which you have selected, and stand by to help while they attempt to use the key by themselves. In two or three class periods (plus a little home study), students can learn to describe the various leaf forms and arrangements, and master the identification of the most common trees. Always remember that identification is not an end in itself but is an important tool.

Tree identification skills can be used in several ways: (1) to observe variations; (2) as a tool in the analysis of a biotic community; (3) as a "handle" to use in consulting references and finding out more about trees which survive, (or do not survive) in city environments; (4) to find out what species are most frequently used as Christmas trees or for other observable commercial purposes.

Individual projects:

The assignment of individual studies is an excellent device which serves several purposes. It gives flexibility to the program in that it offers opportunity to students of many interests and abilities. It is a way of utilizing laboratory experiences within the difficult

limitations of space, equipment, and schedules. Finally, and most important, it offers students the experience of doing a real research study.

In giving this type of assignment, *the teacher has the important responsibility to give guidance and at the same time to allow students to assume responsibility*. The kind and amount of guidance is the key to success or failure of the assignment. The teacher must suggest studies, help students plan them, and help students pace their work so that something is accomplished. Only a small percentage of students are able to go through these important steps without help.

Suggest: Make a list of suggested studies and let these suggestions be specific. Your ability to do this increases with your own experience. Suggest some long term studies and some short term ones. Let all your suggestions involve direct observation and/or experimentation. Always leave the door open for the student to modify the idea and adapt it to his own opportunities. Give the student some choice; that is, put him into a situation where he has to make some decision, but let this decision be within the range of his abilities and experience.

Help Plan: One or two class periods may be used for discussing the suggestions, and outlining some necessary steps of procedure. These steps will include: a) selection of topic, b) listing questions you hope will be answered as a result of the study, c) making a tentative plan of procedure and schedule of observations and record-keeping.

Set up a series of deadline dates: Last minute failure can be avoided if students are carefully checked at each step. A conference with each student is desirable, but large classes and crowded schedules make this almost impossible. Your conferences can be written ones. A few days after the assignment is given, each student should make his decision as to topic and formulate tentative plans. The student submits this in writing. This is a set of papers which the teacher should read immediately. If they are left lying around for a few weeks, the assignment will be killed. Read these papers carefully, and write comments and suggestions on them, and return them to the students within a few days.

Now set up a *series of dates* for progress reports. You may ask for all of the material which the student has collected to date. If you see this, it will not be difficult to determine how successfully the student is progressing. From time to time, a few students may give oral reports to the entire class. Many of these studies will be quite interesting and worth sharing.

The final report should be presented in some acceptable form. Ability to organize is a clue to understanding. Organization indicates relationships. If your students have difficulty in organizing ideas, help them by asking for an outline a week or two before the final project is due. A final report may or may not be a lengthy "paper". It may be a short paper accompanied by "the evidence"—the the experimental material itself or a series of photographs or diagrams.

Whatever your procedures, the success of your assignment of individual projects will depend on your blending of flexibility with careful, constant, and specific guidance.

The Teacher Continues to Study

Imagination and creativity must be nourished. All of us teachers know that our wells of ideas and enthusiasms run dry if we do nothing to replenish them. It is difficult to suggest and inspire unless we ourselves study and enjoy studying nature. Sometimes our relatives and friends accuse us of making a career of going to school. Perhaps they are right, for we discover that continuous study is essential, and that it is more easily achieved if we occasionally place ourselves into an academic atmosphere.

The summer biological stations offer one of the best kinds of opportunities. They are relatively inexpensive, are staffed by first-rate biologists, and offer flexible programs. At the present time many of these stations have National Science Foundation grants available to teachers. Whether or not you are working toward an advanced degree, attendance at one of these summer sessions every three to four years is certain to "recharge your batteries."

Do you have time during the winter to visit your local zoos and museums? Do you attend lectures which these and other organizations offer? Maybe it will be worthwhile to take time.

Do you live in a city apartment on which the pigeons or starlings roost? What can you find out about these creatures?

The advertisements for vitamins say "Do you feel as though you are growing old?" Perhaps you do, but it may not be a vitamin deficiency. Can you, at the risk of amusing your family and friends, retain youthful curiosity? This, too, is a key to eternal youth and a key to dynamic teaching.

Determining Territories of Male Red-Wing Blackbirds

BETH SCHULTZ and THANE S. ROBINSON
Western Michigan University, Kalamazoo, Michigan

An Outdoor Laboratory Exercise

In two hours, one spring morning, a college class gathered enough data to sketch on a map the territories of red-wing blackbirds nesting in a small marsh.

The procedure was simple enough to be used with any age group which can sit quietly for an hour to an hour and a half.

1. The instructor prepared a mimeographed map of the area, indicating land marks (stream, bridge, path, clumps of bushes, et al.).

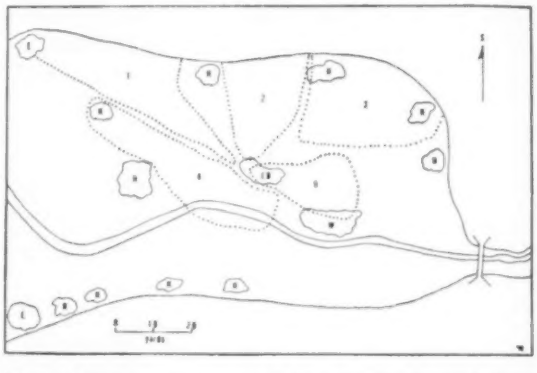
2. The students were led along the perimeter of the area so that they learned to read their maps and recognize male red-wings.

3. Students then took up stations every 200 or 300 feet around this perimeter.

4. Each student selected a male red-wing and observed this one bird for the next hour and a half, using lines on the map to indicate movements.

5. Each time the bird made contact (physical or threatening) with another red-wing male, the student placed an X on the map at the location of the contact.

6. Maps were collected and all data (X's) were put on a single map. The X's formed discernible lines from which territories could be sketched (see illustration).



Map of stream and surrounding marsh situated three miles north of Kalamazoo, Michigan. Dotted lines enclosing numbers 1-5 indicate results of observations by a group of students of the breeding territories of male red-wing blackbirds. Other notations: E-elm, EB-elderberry, H-hawthorn, W-willow.

Arthritis

The cause of rheumatoid arthritis may become less mysterious as a result of research on blood serum. The discovery that the rheumatoid factor, a substance found in small amounts only in the blood of persons suffering from rheumatoid arthritis, is actually a number of closely related protein substances was announced by Dr. Ralph Heimer, a biochemist at the Hospital for Special Surgery, New York.

These newly identified proteins are all very large molecules bearing a structural relationship to common antibodies, the natural defensive agents in blood, he noted. The rheumatoid factor substances also were found to resemble certain unusual proteins associated with hepatitis, syphilis, selected anemias and multiple myeloma (a type of bone cancer).

New Publication

The Conservation Education Section, State Department of Natural Resources, Sacramento 14, California, has just published a new pamphlet on "Natural Areas for Schools," by Verna R. Johnston, Biology Coordinator, Stockton College. It is an illustrated work which should be very useful for school persons using natural areas, and for those who wish to develop them for their own locale.

The Role of the Liberal Arts College In Educating Biology Teachers

HARVEY E. STORK, *Past President, NABT*[1]

Fifty years ago the liberal arts college was virtually the only source of supply of teachers for academies and high schools. Teachers carried the standard college courses in botany and zoology with them to the secondary schools and presented the same materials with the same methods in somewhat simplified form. This is reflected in the textbooks of the period which were simplified college texts in shortened form.

About 1910 the focus of attention began to shift from the standardized subject matter to the needs of the secondary school student, and plant and animal materials were incorporated in a single principle-centered course to be known as general biology. The colleges, however, persisted for a long time to keep plant science and animal science in separate compartments, and some still do. The young teacher, therefore, had to do his own coordinating of the two if he went to a high school that offered the general biology course rather than botany and zoology.

With the rapid growth of the American high school, the teachers colleges, then known as normal schools, began expanding their programs so as to prepare teachers for secondary schools, a move that was resented by some colleges as an encroachment upon their domain. At the same time, departments and colleges of education in the universities began to exert a powerful influence. In the last three decades approximately one-half of the secondary school teachers came from teachers colleges and universities while the liberal arts colleges supplied the rest. When the liberal arts professor therefore criticizes the "deplorable" conditions in the high school, he should be willing to take half the blame instead of directing all of it at the baneful influence of the university schools of education and the dilution of liberal education in the teachers colleges.

Since about half of the nation's secondary school teachers are prepared in liberal arts colleges, it is timely to ask how these colleges are meeting the obligation they owe to secondary education. With an eye on the problem of teacher shortage we may ask what their attitude is toward encouraging young people who have an interest in teaching. Here we find great diversity among colleges. In some, as many as half of the graduating class meet the teaching requirements. In others, considerably fewer are prepared for teaching than might be expected from the average career distribution. Such colleges as Swarthmore, Haverford, Kenyon, and Antioch produce almost no secondary school teachers. In many colleges the tendency has been to discourage anyone from entering the teaching profession. It's been represented as a second-rate occupation, to be considered only if you aren't good enough for something better. They quote the cliche, "He who can does; he who can't teaches." The teacher has lost status and no longer holds the one-time high standing in the community. The low pay has been so widely publicized that an exaggerated idea of starving school teachers prevails. This may be good propaganda to give to state legislators and school board members, but it does not encourage prospective teachers.

Up to two decades ago most of the women who went to college to prepare for a career looked forward to teaching. Today there are so many appeals from other fields that teaching gets fewer and fewer recruits. In one college that prepared an average of 85 men and women for teaching in the five-year period, 1925-30, there were only twelve annually over the past five years. Representatives from airlines, insurance companies, selling organizations, industrial plants, and similar non-teaching areas come to the campuses and do an effective job of recruiting. The placement services on the campuses will tell you that the least effective appeal is made by repre-

[1] It is with sincere regret that we announce the death of Dr. Stork, September 30, 1959. His record of service will be carried in a future issue of ABT.

sentatives seeking teachers. We cite all this in order to point to the need on the college campus of some united effort to put the profession in its true light. This does not mean a campaign of high-powered salesmanship. But the least we can do is to make young people aware of the opportunities this kind of career offers, along with others, so that they may choose without the prejudices that we have hitherto tended to build up.

Among the causes of this faculty prejudice there are two that we wish to cite here: (1) The older members of the faculty regard the high school as having degenerated to a degree where they cannot recommend a career of teaching. The impression is that it has become a sort of custodial institution where the young people are kept out of the labor market and out of gangsterism for four years in a curriculum of athletics, driver education, music and debate contests, baton twirling, and similar delectable pursuits. The old solids have given way to courses in adjusted living, technique of dating, etc. As proof of their position they cite glibly the cases of high school graduates who come to them unable to write and spell, and uncertain when to multiply and when to divide, or how to perform either operation. Their knowledge of the modern high school, its population problems, the philosophy of those responsible for its curriculum, and the social pressures that shape it, is appallingly meager. The attitude can best be summarized by the glib pronouncement of one professor who said, "The trouble with the high school today is that one-third of the students don't belong there; they shouldn't be there at all." He didn't say where they should be.

(2) A second factor in the prejudice against teaching lies with the younger members of the faculty who have achieved the PhD degree in a university where the warfare between the subject matter professors and the education professors has driven them to take sides with the former, and they have learned to belittle education courses. Highly imbued with the importance of their own subject, they would like to see their students prepare for graduate work in their own field rather than "to waste all that time on education courses." Their counsel is: Anybody can teach in high school. You are capable of better things. If you want to teach, go on to graduate school and prepare for college or university teaching."

The four-year college curriculum for the education of teachers falls into three areas:

1. The general liberal education in languages, literature, arts, the social studies, and the sciences.
2. The special subject matter which the prospective teacher is going to present.
3. The professional courses required for certification in teaching.

Of these, the first is often undervalued and even neglected in order to favor the second. Yet the biology teacher should be a liberally educated person first and a biologist second. The basic mission of any teacher is to transmit the cultural heritage, to open up wide vistas looking into space and time, to acquaint the student with the best thinking of great minds, to dispel the illiteracy all too common in the areas of literature and the fine arts, and to disinfect against the virus of creeping anti-intellectualism.

The vocational and the professional areas of our education are emphasized to the detriment of the liberal education that makes truly free men and women in a democratic society. For this, the climate in America is getting to be less and less favorable. We are getting to be a race of technicians that can put together all kinds of machines but we still import the basic ideas from Europe. We make beautiful chromium electric pencil sharpeners, but when we have sharpened our pencils, what do we write? Sonnets can be written with a stub of a pencil sharpened with a pen knife. One of the physicists in the Nuclear Physics Laboratory in Berkeley pointed out their greatest weakness as being in the theoretical areas. They built the bevatron that delivers 4 to 5 billion electric volts, but they are short on the type of mind that can lead out into new uncharted directions. Leadership is lacking. What is wanted is masters rather than hirelings. Strange to say the call for the broad liberal view is coming from business and industry who recognize the need for long broad vision in planning future progress; they are prescribing broad general education as important along with the technical.

Whatever success the liberal arts college has had in the preparation of teachers, must be ascribed in large part to their emphasis on this first phase of the education of a

teacher. Should this part of the teacher's education be specially tailored to fit his needs? The answer of Paul Woodring is no. That curriculum, which is best for general liberal education of the citizen, is also best for the prospective teacher. With this view we find a considerable weight of agreement. But that does not mean that the present teaching is the best for either category. Too much emphasis is placed on preparation for the graduate school and the professions, to the detriment of the truly liberal viewpoint.

When we come to a consideration of the second phase of the teacher's education—preparation to teach biology, we must guard against nearsightedness. We are prone to prescribe so many courses in biology and the supporting chemistry, physics, and earth sciences that we lose sight of the first objective that we have just presented.

The third area—the professional training—is often regarded as a necessary evil by liberal arts professors. Yet if they sit down to study the problem, they generally arrive at an admission that a beginning teacher must see his work in the light of the meaning, purposes, and problems of universal public education. He must possess a knowledge of the learner and the learning process. He should have some introduction to methods, materials, and curriculum organization, and this should be closely correlated with his educational philosophy and his knowledge of the psychology of learning.

Now I know that when we come to add up all that is desirable in the three areas we will come out with considerably more than can be encompassed in four college years. A five-year program has been adopted in some states and is under consideration in some others. This need not mean a solid block of five years but might accumulate over summer sessions or a year's leave for study after some experience in teaching. In some situations apprentice teaching is also possible. What we would emphasize here is that a teacher shortage is not a valid excuse for not raising requirements. Let the requirements be raised and temporary certificates be issued for a limited time until the requirements can be met. Raise standards first and salary scales will follow, as has been demonstrated in the medical and other professions.

In a study of teacher education by the faculty of Carleton College the past year, one recommendation stood out above all others. This problem is the business of the entire faculty and requires concerted effort. It cannot be shunted off to the Department of Education. The first need is for better information on the part of everyone as to the nature of the modern high school and the problems that confront its teachers. This was achieved by a seminar on teacher education, by calling in representative high school teachers to give advice, and by visits by some faculty members to high schools. The faculty learned many things, and there was considerable change in attitude. The faculty themselves set up a permanent committee to serve as a clearing house. The education and psychology professors are merely advisers to this committee.

The permanent standing committee authorized by the Carleton College faculty was charged with responsibility for

1) Co-ordination among subject-matter departments in the approach to teacher education, particularly in special methods courses.

2) Liaison between subject-matter fields and the Education Department.

3) Establishing and maintaining liaison between Carleton's teaching staff and classroom teachers in secondary schools.

4) Making available to interested students such information and guidance as would be helpful in deciding upon, or preparing for, secondary-school teaching in particular subject-matter fields.

5) Promoting the general recognition, by students, faculty, and public, of the fact that secondary-school teaching is a responsible and worthwhile career of public service and one in which many graduates of this college could make great contributions.[2]

[2]The Carleton Faculty Study of Teacher Education, Published by Carleton College, Northfield, Minnesota. 1955.

Nature Conservancy

Membership in The Nature Conservancy at $3.00 is available in the organization, 2015 Bunker Hill Road, N. E., Washington 18, D. C. Those of you who know the work of The Nature Conservancy will be anxious to assist them in their program. Feel free to write to their address for further information.

Photoperiodism: Bringing Classroom Biology Up-to-Date[1]

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and
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For the past several decades considerable study has been given to the role light plays in controlling the growth and development of living organisms. Although the term "photoperiodism" occurs much more frequently in the literature of botany than that of zoology the phenomena with which it is associated has been shown to be important in the lives of both plant and animals.

"Photoperiodism" is generally defined as the response of plants or animals to the relative length of the day to the night. The "photoperiod" is that length of time during which an organism is exposed to light. Under natural conditions this would normally be some portion of 24 hours, but under experimental conditions this may be of any duration. In the nearly forty-year period in which light effects have been extensively studied all manners of light to dark ratios have been tried.

The potent effect of light/dark exposure on plants has been a surprise to many investigators. For instance, cocklebur (Xanthium) plants have been kept in the vegetative or nonflowering stage for indefinite periods by not allowing a plant to enjoy a continuous dark period of 8.5 hours or longer. Thus if a cocklebur plant is exposed to light for 16 hours each day it will not flower. If however, it is left in darkness continuously for 8.5 hours it will flower in the normal manner. An interesting observation is that the cocklebur will not flower even if it is in the dark for 8.5 hours if during that time a flash of light interrupts, even for a half-a-minute, the continuous dark period. The present use of flashing lights in keeping sugar cane crops vegetative and nonflowering is thus easily understood. It should be noted that light/dark control of flower initiation will not occur until a plant is past the juvenile stage and in the "ripeness to flower" condition. Also, a light intensity of as low as 0.3 of a foot candle has been used effectively to prevent cocklebur flowering.

Cocklebur is an example of a "short day" plant—one which needs a length of day shorter than some particular critical length. It is generally belived now that it is actually the daily dark periods which induce or accelerate flower formation. In the case of cocklebur the day must be shorter than 15.5 hours or the dark period longer than 8.5 hours for flowering to occur. Other "short day" plants include Maryland Mammoth tobacco (12 hrs.), Biloxi soybean (15 hrs.), Klondike Cosmos (12.5 hrs.), Queen Mary Chrysanthemum (14.5 hrs.), poinsettia (12.5 hrs.), and strawberry (*Fragaria chiloensis*, 10 hrs.)—these plants being ones that flower with the shortening of the days in the fall.

On the other hand, there are plants which need a length of day longer than a particular critical length (or a dark period shorter than a particular critical length), and these are termed long day plants. In these the daily dark period probably inhibits or delays flower formation. Included in this category are dill (11-14 hrs.), henbane (10-11 hrs.), spinach (13.5 hrs.), red clover (12 hrs.), coneflower (10-12 hrs.), and oats (9 hrs.). Under natural conditions these plants flower in the lengthening days of late spring and summer.

Another group of plants including buckwheat, sunflower, tomato, cotton, some squashes, and cucumbers do not seem to have their flowering controlled to such an extent by light. These plants are known as "indeterminate" or "day neutral" plants. Unfortunately for the lawn owner, dandelion is in this category also.

With animals the most striking effects of photoperiod are those on reproduction habits. It has been shown, for instance, that with 8

[1]Presented to the NABT meetings at the AIBS sessions at Pennsylvania State University, August, 1959.

additional hours of light, brook trout can be induced to spawn 4 months in advance of the normal spawning period. Experiments on field mice (*Microtus*) have been conducted in which shortening the daily period of exposure to light virtually prevented reproduction, particularly with the females. The color change in the feathers of the ptarmigan, and in the coats of the varying hare and ermine, are more obvious effects demonstrated to be controlled by light. The fur color of the varying hare can actually be caused to turn white out of season by appropriate lighting conditions.

Somewhat analagous with plants, animals can be grouped into those that breed in response to increasing daylength and those that breed in response to decreasing daylength. In general, animals with short gestation periods such as field mice, ferrets, raccoons, squirrels, and cottontail rabbits breed in response to the longer daylength along with many birds including the junco, crow, canary, starling, chicken, sparrow, pheasant, and grouse. Sheep, deer, and goats, animals with long gestation periods, breed in response to the shorter daylength. An important application of these facts that the U.S. Bureau of Animal Industry has been investigating concerns the possibility of using controlled photoperiods to bring about fall lamb production in sheep and summer breeding in goats to insure winter milk production. One discovery of their work was that kids which were born from January to June were significantly heavier than those born from August through December. By shifting the dark/light ratio from its normal seasonal occurrence, the animals can be brought to breed at any desired time of the year. There are animals that are apparently little influenced by photoperiods and in this category are ground squirrels, prairie dogs, and guinea pigs.

To explain the effect of light/dark periods on plant flowering, numerous theories have been proposed which suggest that a flower-promoting hormone, frequently referred to as "florigen" is produced in the leaves under the proper conditions. Until the 1959 A.I.B.S. meetings, no one had reported isolation of such a substance. At those sessions, however, a team of scientists from Beltsville, Md., working with Dr. Sterling B. Hendricks, reported on their isolation of a protein-containing pigment that changes its chemical structure when red light strikes it. Since red light is known to play an important part in the flowering process it is felt that the uncovering of this unnamed, unanalyzed material may be the major break-through plant physiologists have been anticipating. Naturally much more research is still needed before any real facts can be established, but another giant step in the prodding progress of science may have been achieved.

In the past it has been shown that exposure of only a small fraction of even a single leaf to the proper light/dark conditions has a controlling effect on flower development throughout the whole plant. Research has followed the concept that a stimulus is received in the leaves and is carried down from the leaf to the growing tip. Experiments have been carried out that seem to show that the "stimulus" passes a graft but will not cross a girdle. It has also been shown that certain wavelengths of light seem to inhibit flower development while others seem to stimulate it. The interaction of other environmental factors such as temperature with the light have been studied and show that in some plants and animals a dual factor is operating while in others light itself is the cause of the effects.

In most animals the photosensitive receptor would appear to be in the eye with the optic nerve transmitting the influence of the light to the anterior lobe of the pituitary gland. Under the proper conditions the gland produces hormones which cause a rapid increase in the size of the gonads along with changes in their structure which lead to production of gametes. Ferrets, for example, have their

Figure 1. Lights controlled by the timer (right) provide long days which prevent flowering of the cocklebur plants.

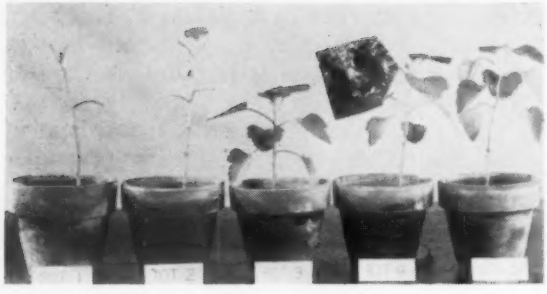

Figure 2. Cocklebur plants prepared for the experiments described in the text.

sexual cycle conditioned largely by light waves in the visible part of the spectrum but show no effects when hoods are placed over their eyes. One investigator reports, however, that simply flashing a light on the roof of the mouth of ducks, whose optic nerves have been severed, brought about gonad development—the assumption being that light may affect the pituitary directly as well as being transmitted as a stimulus through the optic nerve.

Besides the influence it has on flowering, light has been shown to affect plants in other ways. Shortening of the photoperiod usually favors tuber formation and has, in some cases, actually checked stem elongation. In onion, a long photoperiod favors bulb formation while similar periods inhibit lettuce germination. In the case of strawberry, sexual reproduction is induced by long nights while asexual reproduction is induced by short nights. Alteration of light and dark exposures every minute have actually caused death in some plants. With animals such activities as bird migrations seem to be as dependent on photoperiod as on temperature, and it may be that seeing his shadow really has sent the ground-hog back to bed.

In any case the importance of light in the development and growth of organisms has been established, and many of its effects can be demonstrated in the classroom. A number of worth-while experiments can be carried out with very little equipment and a range of common plants. One such effective demonstration which uses the common cocklebur plant, discussed in some detail earlier, follows:

Demonstration of Photoperiodism

Object: To illustrate the photoperiodic effect and to demonstrate that the floral stimulation is produced in the leaves.

Materials and Equipment Needed: Cocklebur (*Xanthium*) seeds, light bulb illumination (the time period is controlled most easily with a timer or a clock radio with an outlet but these are not essential), light-tight growing chambers (desk cupboards, closets, cardboard containers, oatmeal boxes, etc. are fine), a piece of aluminum foil, and plant pots with soil or vermiculite.

Seed Germination and Potting: Start the seeds in the dark and pot them as soon as the first true leaves appear, placing 2 seedlings in each of five 4″ or 5″ pots of soil and place them immediately under long-day conditions. Use artificial illumination, when necessary, to provide along with the daylight, a total of more than 16 hours of light. After 3 or 4 weeks, when the plants have 6 or more leaves, they are ready for inductive treatment.

Experiment Set-Up: Prepare each of the 5 pots of plants as follows and label each pot:

Pot 1. Remove all the leaves from the plants including those with leaf blades longer than ¼″. Do not remove the terminal bud.

Pot 2. Remove all but one of the leaves from each of the plants. The remaining leaf should be about one-half expanded or with a blade about 1½″ long.

Pot 3. Allow all of the leaves to remain on the plants. Place the above 3 pots on the short-day, long night cycles using the dark chambers as described earlier.

Pot 4. Allow these plants to remain on long-day conditions under the lights. Do not place them in the dark chambers. Allow all of the leaves to remain on the plants, and cover a single, half-expanded leaf on each plant with aluminum foil, making an envelope by folding the edges over. (Be sure the envelope is light-tight.) Place the envelopes on the leaves at about 5:00 p.m. and remove them at about 8:00 a.m. for at least two consecutive nights.

Pot 5. Allow these plants to remain uncovered, under long-day conditions as controls.

After the inductive treatment return all the plants to the long-day conditions under the lights.

Observation: Examine the plants periodically for the appearance of the terminal staminate flower bud. This should appear on the plants in pots 2, 3, and 4 as separate, rounded

structures, surrounded by leaves and should develop within two to three weeks.

Comment: The critical daylength for cocklebur is 15.5 hours. The plant will flower if the length of the day is less than 15.5 hours but will not flower if the length of day is greater than 15.5 hours. The optimum conditions for inducing flowering in cocklebur are those which involve periods of 9 hours of light and 15 hours of darkness. A deviation of an hour or so from this schedule, however, is not critical. Cocklebur is monecious. The staminate flowers appear first and develop from the terminal bud while the pistillate flowers, which become the burs, appear in the leaf axils. Subject the plants to at least two short-day, long-night cycles. Although one cycle is sufficient to induce flowering in this species, results will appear more rapidly when the plants are exposed to more inductive cycles.

The bibiography listed below may enable students to find their next investigation in "photoperiodism."

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Germ Warfare

In the event of germ warfare, at least one warning method is known which could quickly detect the germs in the air. Dr. Carl O. Thomas, a chemist of the Bell Telephone Laboratories, Murray Hill, N. J., revealed a technique by which airborne protein matter, associated with germ warfare agents, can readily be measured by chemical means. Recently declassified by the United States Army Chemical Corps, the method was developed several years ago at the Southern Research Institute, Birmingham, Ala., in research performed under contract to the Chemical Corps. It was emphasized that the technique, although of possible use, would not necessarily be the method used in case of an attack. There was no assurance that any fully satisfactory alarm system has been developed.

The method is based on the expectation that bacteriological agents would be dispersed in air along with a considerable amount of protein matter making up their culture medium, according to Dr. Thomas. The germ warfare agents, themselves made of protein, require protein nutrient to make them multiply and stay alive until they reach their targets. Pollen is also protein material, and it may be possible to detect pollen in the air by the same technique.

To test the air for the presence of protein, some of the air was passed through a small glass tube where it was heated to 600 to 900 degrees Fahrenheit, the chemist explained. In this temperature range, protein undergoes pyrolysis—decomposition by heat—and forms, among other things, hydrogen cyanide. The gases containing hydrogen cyanide were then passed through a caustic solution, which traps the hydrogen cyanide.

"Very simple electrochemical methods have been developed for the detection of extremely small amounts of cyanide," said Dr. Thomas. "Therefore, it was possible to combine the pyrolysis and the electro-chemical techniques and to detect a few micrograms of protein per liter (a few millionths of an ounce per cubic foot) of air. The method thus provides a very simple, sensitive, and rapid technique for indicating the presence of bacteriological warfare agents in the air."

An indication of protein in the air is not conclusive proof of the presence of bacteriological attack, since many other naturally occurring and relatively harmless proteins are present in the air from time to time, he cautioned. If used to warn of germ warfare agents, it is expected that the device would monitor the air and detect sudden increases in protein content which might be attributable to bacteriological warfare agents.

Some Principles of General Ecology and Human Society*

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Human ecosystems run the gamut from relatively small and simple to very large and complex. Man is both the most cosmopolitan and the most important influent among species. This results in almost all ecosystems having been penetrated and modified by man, and the vast majority of the earth's surface having been occupied by him. In general, then, a study of ecology without consideration of the roles played by man can give only a partial view of communities and ecosystems, and a study of man without due consideration of his biotic and abiotic co-members of the ecosystem can be misleading as to his opportunities and his limitations. We can conclude that the principle of the universality of communities applies equally to man as to the rest of nature, and that the term "community" is generic and is applicable to any level in the hierarchy of systems in which man participates.

Human communities, however, have a complexity of an entirely different order of magnitude from those in which man does not participate or which he influences only moderately. The powers of written language, conceptual thought, including his awareness of himself and the roles which he plays, and of the tools at his command which he has invented make him incomparable in social structure and effective action on the ecosystem. This affects not only the complexity of human ecosystems as a whole but results in elaborate intra-specific organization as is most apparent in cities and "modern" countries but is relatively true even in primitive rural society. This phenomenon, which is basically related to differentiation and division of labor among men and the roles they play, is so apparent and important that many sociologists focus attention on social and community structure, almost to the exclusion of function. This has, of course, been done by general ecologists as well as by human ecologists and is justified as a partial and tentative approach because all functions have a physical basis of performance. Yet, as pure description, it can be sterile, just as concentration on function alone can be futile. Function and structure together—the community in the ecosystem—offer objective reality in nature. Knowledge of the whole, even though partial and approximate, rewards understanding.

General ecology has much to say about the structure of communities and the significance of synusiae as structural units and niches as functional roles. In one frame of reference we can conclude that human society constitutes a synusia of the community in the general sense and that the niche man fills is that of an omnivorous consumer. It is equally clear that man is a proto-dominant whose role goes far beyond his position in the food web or any ecological pyramid. His role includes his capacity to modify favorably, and sometimes unfavorably, the productivity of the ecosystem in goods and services to meet his needs. In another frame of reference we know that human social structure consists of many strata, analogous to niches in the extra-human ecosystems.

We can speculate that those societies which are relatively simple and homogeneous and are limited in the variety of roles for individuals (analogous with niches) have limited social opportunity. This would apply not only to the economic sector but to all aspects of culture. In contrast, those societies which develop a rich variety of personal and group opportunities with an implied freedom to fill them would be more capable of rapid and rich cultural development, including but not confined to economic growth. In the sense of these remarks, the role or job is analogous to the niche or functional role of general ecology, and can be referred to as a *sociotype*. A society that is rich in sociotypes would of necessity also be rich in institutions, working

*This paper constitutes the remarks of the Retiring President of the Ecological Society of America at the AIBS meetings at Pennsylvania State University, August, 1959.

groups, and local specializations which are analogous to microhabitats or biotopes, and can be referred to as *sociotopes*. The differing structures of human societies in the above regards are comparable to the communities of general ecology which differ in their degree of stratification.

It is not possible to substantiate such reasoning by quantified details, but perhaps historical observation suggests that something like cultural heterogeneity would help explain the success of West Europeans, and especially the British, during three centuries when they have multiplied prodigiously and occupied tremendous and diversified territory in North America, Africa, Asia and Oceania. This culture developed a great richness in sociotypes. In contrast, perhaps, are the Spanish-Portuguese people who during about the same period were able to conquer but not to hold, fully occupy and exploit Central and South America. Was this because of their failure to develop fully the cultural sociotypes (niches) and sociotopes (synusiae) which are necessary for full exploitation of the physical environment? In any case there is today a strong contrast in the "wealth" of Canada, the United States, Australia, New Zealand, and the parent country, too, and the comparative "poverty" of Latin America generally. Such contrasts between developed and underdeveloped countries seem not to be due so much to differences in exploitable natural resources as to differences in the development and utilization of human resources.

Antecedent causes lie in the cultures themselves in, for example, such matters as general illiteracy and the emphasis in traditional Latin education on law and the humanities and a de-emphasis or virtual exclusion until recently of natural and social sciences and administration and management skills, which is in great contrast to West European tradition.

The great cultures in existence today are perhaps analogous to the world formations or biomes of the nonhuman biotic world, and they certainly show the same kind of internal variation that is better ordinated as continua in correlation with influential organizing forces than in "association types," but the comparison can't be safely pushed very far. For one thing, as will be developed later, human ecosystems are much more interdependent than those of general ecology, even to the "four corners of the earth," and natural communities do not and cannot experience anything like acculturation. Although one can recognize actions, reactions, and coactions in human ecosystems, and the fact that much of the operation of the action system takes place within comparatively small space, as it does in natural communities, the fact remains that human ecosystems are influenced at a distance by ideas and by the transport over great distances of materials and energy, into and out of different ecosystems of neighborhoods, areas, regions, nations, cultures. This is an essential and fundamental difference between the structure and function of human ecosystems and those without man as a predominant influent.

Still, man is a part of the trophic network of the ecosystems in which he participates. He eats and is eaten. He competes with much of the rest of nature for her bounty or for the fruits of her niggardliness. And as is the case for all species, his strongest competition is with his congeners. This analogy can be pushed even farther, for in human society the strongest competition is among men of equal power endeavoring to occupy the same space. To revert to the technical terminology used above, the strongest competition is among men of the same sociotype occupying the same sociotope.

From among the principles of general ecology concerning the structure of communities we can draw further observations on the similarities and differences of human ecology. For example, there is a parallel in the principle of intracommunity surface which states that stratification provides not only increased variety (synusiae and niches) but also increased surface and edge. The latter point concerning the marginal places and conditions, the "gray zones" between places and functions that are clearly recognizable, is an important one, for it allows opportunity for the "misfits," the organisms that do not fall into types. There is no question but that such heterogeneity increases the functional as well as the structural richness of a community, and that its very variety provides increased ecological opportunity for the community as a whole. This can be measured in the increased dynamism of the community and in its increased adaptability and survival value.

On the other hand, although stratification increases in natural communities with ontogeny and succession, and human ecology with the growth of cities, for example, it seems certain that these phenomena are not parallel, as will be clear, I believe, from a consideration of the principles of general ecology which relate to succession. To be analogous with community succession as understood in general ecology, human ecosystems would have to show orderly, directional sequences that tend toward climactic communities which are in long-enduring dymanic equilibrium with the general environment. History, in its description of the rise, culmination, and decline of civilizations is antithetical to the concepts of succession and climax. Our human utopias are only in fiction. The changes observable in human ecosystems are more of the order of microseres and microcycles.

Take the growth of human population centers. Here one may find several kinds of microseres which show parallelism if not duplication from place to place under comparable circumstances. For example, as villages grow into towns and cities there is a succession of land-use types that occurs: in-town residences give way to retail commercial establishments and later to large commercial or industrial buildings. Another grander type of residence more peripheral to the village becomes the funeral home or insurance office of the small city. Perhaps another microsere is the change from single-family homes to apartments, first by subdivision, and later by erection of new and larger structures.

Perhaps some microcycles may be detected too. Streamside or other waterfront locations in what becomes an urban center may progress from open countryside to farms, to suburban residences, only to be engulfed later by the city proper, and eventually returned to open country as a greenbelt, park, or parkway development. The phenomenon of microcycles seems clearly to be represented in much of man's agricultural practices. Perhaps the best example is found in the shifting agriculture, known as the milpas system in Latin America, but characteristic of the subsistence agriculture in humid tropics everywhere, which consists of cut, burn, plant, abandon, bush fallow, cut, burn, plant, etc. Temperate agriculture also has its cyclic patterns in cereal, legume, root crop, and fallow rotations.

We should notice, however, that sequential changes in human land use have in many cases an irreversibility that is rooted in economics rather than in technology and that seems to lack a counterpart in general ecology. For example, agricultural lands overwhelmed by the sprawling suburbs of a metropolis appear certainly to be lost permanently to agriculture. Only the catastrophic failures of government in the management of resources and political power coupled with the social disorientation of a people can return cities, so history would suggest, to shifting sands, scraggly wiregrass, and the foraging hyena.

The most meaningful interpretation of communities and ecosystems in general ecology is that based on energy relations, and human ecosystems form no exception. Yet energy relations form a fundamental difference between modern human ecosystems and those not dominated by man, for neither man's sources of metabolic energy nor those of external energy have a necessarily close relationship to the site of a particular human ecosystem as they do in the rest of nature. Not only exotic luxury foods but basic ones are transported from one human ecosystem to another, tens, hundreds, even thousands of miles. And solid, liquid, and gaseous fuels move around the world by trucks, trains, pipelines, tankers, and freighters, and hydro- and steam-generated electricity is transmitted hundreds of miles. Not only food and other energy sources but innumerable other materials are moved freely from one place to another, not by the forces of unassisted nature, but by the means of transport invented by man. Finally, and most significant of all, man propagates his ideas and beliefs by all means of mass communication, himself moves about physically, and takes along for the ride, purposefully and inadvertently, many of his fellow creatures, including pests and disease.

One of the most important challenges to modern man is to devise political and economic systems of exchange of materials that are equal to the technology of transportation. Sometimes knowledge, ideas, and ideals move freely and with great rapidity, penetrating international curtains, whether iron, bamboo, or linen. But the mere movement of materials and the dissemination of ideas is not enough. As any biogeographer knows, the disseminated propagules of a species must arrive at a proper milieu if they are to establish them-

selves. Herein lie the problems of modern technical assistance, as they always have of conquest.

It follows that although in general ecology the natural-resource base which supports a community is a provincial one, modern human ecosystems develop far reaching interdependencies.

In view of this phenomenon we can conclude that for industrial civilization the ultimate human ecosystem is a world-wide one and that all others are only partial sub-systems. This view, that evolving human ecosystems must ultimately unite or converge on a world system involving the entire biosphere of the earth, is the view of Vernadsky and other biological and social philosophers.

This, however, is not only an international problem. The degree of interdependence which has developed is no more clearly seen than in a modern city which would cease most vital functions almost immediately and fall into catastrophic confusion if the flow into it of its supply of even one critical resource, say food, water, or electricity, were interrupted only a few days. For a nation adjustment or death can be worked out over a somewhat longer period of time. The United States government, for example, has as a general target three-year stockpiles of strategic materials such as tin, lead, zinc, copper which are not produced within its borders at all or at insufficient rates.

Students of economic geography and economists interested in the location of economic activity have been producing some analyses of the patterns of structure and function which develop in and around cities, in regions, and in the world. For example, one hypothesis of the city concerns itself with the concentricity of zones of trophic levels: the central consuming city surrounded by shells of productive activity—first the truck gardens with high value or perishable produce, then in succession dairy farms, crops, meat stock, forests, and wildlands.

The modern touch to all of this is the spread of the realization that man can plan the organization and development of his synusiae and niches, to return to the useful terms of general ecology, and make more satisfactory the functional interrelations in space of his various activities. In fact, he must plan these matters if his ecosystems are to function efficiently and with some prospect of durability.

Planning, which can and presumably should occur at all levels from the family and the firm to the city and the region and the nation and the world, would profit from compliance with ecological principles. Since all biological systems are open, requiring a continual inflow of materials and energy to replace those lost by entrophy (the physical dispersion of material such as copper can be considered as analogous to the degradation of energy and its loss from useful form), all planning can be directed toward the reduction of waste and loss. Another fundamental ecological principle that planners should never lose sight of is that of the interdependence and interactions of the many parts of both the abiotic and the biotic sectors of ecosystems. This fact should lead man to expect an action of his to have repercussions on the ecosystem, affecting different elements of the ecosystem in different degrees, but certainly changing more than may have been intended by the single action. This phenomenon leads also to the conclusion that effective action on the ecosystem in some direction desired by man is likely to require the coordinated action on many elements of the system, rather than on single elements, if the goal is to be attained. Man can't affect one element of an ecosystem without affecting others in that elastic web of causes and effects, and he can't obtain a desired change in one element without changing others because of the natural interdependencies of the ecosystem.

This does not mean that society has no need for specialists, but rather that the effective actions of specialists must be in relation to one another. The large corporations know this, and so must those who would guide the destinies of cities, states, nations, or any other socio-political unit.

My talk here tonight has not been formulated as a brief either for or against the inclusion of the large field of human ecology in the biological sciences. Instead, my purpose has been rather the tricky one of applying some of the general principles of ecology by analogy to the world of human affairs.

Drawing analogies from nature has long been a custom of some ministers of the Gospel, with scientific accuracy often sacrificed to moral exhortation. It has been a province of the poets as well. I see no reason for an

ecologist's shunning such applications on this account, for when pursued with scientific comprehension, the analogies afforded by ecological principles may not only give us fresh insights into the existing structures and functions of human communities but likewise give us some notion of both our limitations and unrealized opportunities in the ecosystem which is our home.

What Jobs in Science?

Jobs for qualified scientists, engineers and technicians are due for a big increase in the next ten years. Results of a recent survey by the Scientific Apparatus Makers Association public information committee indicate how top executives of the country's 500 largest firms estimate their increased technical personnel requirements for 1968. They were asked to estimate percentage increase or decrease in technical jobs in their industry.

A substantial 27% of those who replied said that 10 years from now their industry would have to double the present number of technical jobs. Another 13% thought that the increase would lie between 50% and 100%. In all, 60% of the men forecasted increases of 25% or more.

The SAMA committee conducted the survey to guide capable young people now beginning high school as they planned their careers. Committee spokesmen point out, qualified scientist-engineers and technicians so badly needed a decade from now must be "recruited" today.

Food, chemical, rubber, petroleum, electrical and instrument industries led the industrial group in their projected professional needs with furniture and paper pulp indicating lesser growth needs.

Of the 500 questionnaires mailed by the SAMA-PI committee, 103 were returned. 67 gave usable (percentage) figures. Among those responses roughly one-third were from chemical or related industries, e.g., petroleum, rubber, etc.

The SAMA committee felt that this recession year when the demand for new technical graduates slipped to its lowest point the study would be most timely in reaffirming America's potential for professional people.

SAMA survey results become even more significant in the light of recent studies at Hughes Aircraft Company. Here it was found that 70% of their technical employees decided to enter scientific fields well in advance of high school graduation. 41% had decided on their careers in seventh and eighth grades; another 29% had decided during high school.

If the demand for scientist-engineers by 1968 will be doubled and more in relationship to today's demands, technicians or scientist-engineer helpers—"hands"—are in for even greater job opportunities. This was learned when the SAMA survey posed another question to the country's leading executives: "What's the 1968 outlook for technicians and engineering helpers?"

Here, as a typical example, one of the nation's leading pharmaceutical laboratories predicts a 150% increase. Another executive, W. J. Harshaw, board chairman, The Harshaw Chemical Company states, "I believe the demand for this group will increase over 100%, possibly 150%. Opportunities for technicians and technically trained helpers are always developed in sales, production, accounting and other allied fields."

Donald P. Boyd, The Curtiss Publishing Co., points out that the need for technically trained men will expand with the need for engineers. "One of the most rapid fields of growth in this respect will be in data computing and other electronic equipment," says Boyd. He looks for a different type of training for these people and in many cases an upgrading of personnel specifications to a more technical level.

"While the ratio of technicians to professional people may vary from 1 to 1 all the way to 4 to 1, a steadily growing demand for engineers and scientists will certainly bring a corresponding demand for their assistants," points out R. F. Crawford, Armco Steel Corp.

Leslie Kimon, vice president of research and development for Carborundum, adds that the proper training of technicians and the dignifying of this field are among the best ways to solve the shortage of scientists and engineers, and to clear the classrooms made crowded by persons who are not really college material, but who feel that they must have the stamp of the college degree for social and economic status.

I Am Happy Teaching Biology in a Small School

IRVING C. KEENE
Weston High School, Weston, Massachusetts

There are many young biology teachers who are looking forward to teaching some day in a large high school. I hope to show in this article that teaching biology in a small school has many more advantages than teaching in a large school.

I feel I am fairly well qualified to discuss this matter having taught biology a total of 31 years in five different high schools with enrollments ranging from 225 to 2100. This year I am beginning my second year in Weston High School, Weston, Massachusetts, a school of 451, resigning my position in a school adjacent to Boston, with an enrollment of 2100 students. I had taught there for 12 years. Why did I make the change and why am I happy in a small school?

Most biology teachers whom I talked to, both locally and those I meet while attending our NABT conventions, tell me the thing they like best or wish they had, is the freedom to teach the way they feel biology should be taught. In large schools freedom in some cases is reduced to a minimum. There are usually four or more biology teachers, all of whom are usually required to be on the same unit at the same time. The head of the department may insist on this for it simplifies administrative problems. Everyone must keep pace. On the contrary, in the small school, where there is only one, possibly two biology teachers, there is a freedom and a challenge to expand or shorten a unit depending on the interests of the students and the enthusiasm and skill of the teacher. This freedom does not prevent the essential material from being covered.

In the large schools, it is impossible for the administration to give as much attention to individual problems and interests of the teachers as they would like. I have seen the ability of talented teachers destroyed in order to keep them in line with the average. This does not happen in the small school. The principal and head of the department have only a few steps to take down the corridor to observe the learning activities going on in the laboratory. They understand clearly what the teacher is trying to accomplish and are willing to do all they can to help. They want to make their teachers happy. When they have a good teacher, they want to do all they can to keep him.

I am a firm believer in using as much of the out-of-doors in the teaching of biology as is possible. We take field trips during class periods and the students are encouraged to fill the laboratory with living things. Most small schools are located in country areas. It is possible for me to have my classes in a wooded area in three minutes time. In my former school, the laboratory was on the third floor. The school was located in a fairly thickly populated area. Field work was very limited. In large schools, there are bound to be some teachers who are perfectly satisfied to teach from the textbook, dictate notes, and use only films, pickled specimens, and charts for visual aids. You can imagine the conflict that is bound to arise when another teacher wants to acquaint the students with living things that they can see, touch, and work with.

As the population increases in the suburban areas, new high schools are being built. The biology laboratories and equipment I have seen in these new small high schools is out of this world. The opportunities the biology teacher will have will offer a challenge that will never be theirs in the large schools. When a teacher is presented these opportunities, they are bound to be happy.

As more and more people move out into the suburbs and build their own homes, they have a pride not only in the community but in their schools. The people in Weston want nothing but the best in education for their children. They have just voted with little debate, over $2.5 millions to build a new high school on a 65-acre tract of land. They are willing to pay salaries comparable to the salaries in the large school systems. The administration and the townspeople want to obtain and retain good teachers.

So, young biology teachers, may I suggest you think twice before you decide to be a candidate for a position in a large high school.

Introducing the Boring Sponge

JOSEPH L. PARKHURST, JR.
Colonia, New Jersey

If you enjoy picking up shells from the tidal debris of the seashore you have probably wondered about the ones perforated with little holes. The answer to this question might be found at the market when they are shucking a box of oysters. Some of these may be honeycombed in the same way and have a bright yellow color where the shells are cracked. This is the trademark of an amazing sponge, with the name *Cliona celata*, or *C. sulfurea*.

Cliona starts its growth in the warmer months of the year, boring into the shells of oysters and clams, and making a network of tunnels. After consuming the shell the sponge grows over it, forming a cheese-like yellow mass with regular spots. This massive growth occurs in the winter, and specimens can be several feet long and very heavy.

Sponges are a singular group of aquatic animal life, confused for a long time with vegetation, and live by merely filtering tiny food particles from the water. On the inside lining there are specialized cells equipped with hairs to stir up a current of sea water. First the water is drawn through the porous surface and then expelled through a larger opening, or mouth. The conspicuous round holes in the oyster shell correspond with these mouths.

Extensive colonies of *Cliona* on oyster beds of the Atlantic coast cause a considerable annoyance for oystermen. Boring sponges are probably best known in this connection, as fouling agents, smothering oysters, and other forms of anchored life. This habit of boring in sponges, along with certain worms and mollusks, aids in the disintegration of shell heaps on the bottom.

One noticeable thing about sponges is their lack of individuality. Sponges of the same species appear as cake-like crusts near the shore and branch out in deeper water. Two of them growing next to each other may fuse into one large mass. If one is cut up new specimens will grow from each of the pieces.

Some of the other northern sponges are frequently seen in the tide wrack of bays and coves, and you may find undamaged young specimens, or pieces large enough to identify. There are beaches near New York where a single species like *Microciona prolifera*, the red sponge, is the most conspicuous object along tide lines. You might see an outstanding specimen of *Chalina oculata*, a branching type, on a New England wharf when it is brought in and set out by fishermen.

With the exception of bath sponges the average person pays little attention to this interesting part of the animal kingdom. The sponges have been hard to pin down, with such a variety of form and size, and you would have to be a specialist to understand them. Possibly these few lines have been helpful to the beginner, or at least suggest a fascinating subject.

[Editor's Note: Cover picture accompanies this article.]

Conservation Books

The following books are available from the Interstate Printers & Publishers, Inc., Jackson at VanBuren, Danville, Illinois, at 10% discount for single copies and 20% discount for two or more copies:

The Conservation Handbook, The National Association of Biology Teachers—$4.50

Approved Practices in Soil Conservation, Albert B. Foster—$2.50

Our Natural Resources, P. E. McNall—$3.50

Materials for Teaching Conservation and Resource-Use, The National Association of Biology Teachers—35¢

Our Daily Bread, Susan Myrick—$2.04

This Is Our Soil, Ernest D. Walker and Albert B. Foster—$.50

Soil Conservation Workbook—$.75

Supplemental Irrigation for Eastern United States, Harry Rubey—$3.00

Getting Started in Irrigation Farming, Roy W. Dugger—$1.25

Manual for Outdoor Laboratories, Richard L. Weaver—$1.25

Our Soils and Their Management, Roy L. Donahue—$3.75

Science: Suggestions for Teaching, Philadelphia Suburban School Study Council Group "C"—$2.50

Summer Institutes for Elementary School Supervisors and Teachers

The National Science Foundation has made grants to fifteen colleges and universities for Summer Institutes in 1960. The participating colleges will provide specially developed courses in science and mathematics for elementary school supervisors and teachers.

Approximately 550 participants will receive financial support in the form of stipends of not more than $75 per week for the duration of the institute, plus allowances for dependents and travel.

Inquiries should be addressed to directors of the individual institutes named in the following list:

INSTITUTION	*DIRECTOR*	*SUBJECT-MATTER COURSES*
California		
San Fernando Valley State College Northridge, California	Prof. Ruth L. Roche Area of Elementary Education	Astronomy, Geology Physics
San Jose State College San Jose, California	Dr. James R. Smart Department of Mathematics	Mathematics
Illinois		
Northern Illinois University DeKalb, Illinois	Dr. Frederick W. Rolf Department of Chemistry	Chemistry, Physics
Indiana		
DePauw University Greencastle, Indiana	Dr. Donald J. Cook Department of Chemistry	Mathematics, General Sciences
Kansas		
University of Kansas Lawrence, Kansas	Dr. Robert W. Ridgway School of Education	Biology, Physical Science
Louisiana		
Southern University Baton Rouge, Louisiana	Dr. Woodrow H. Jones Department of Biology	Biology
Michigan		
University of Michigan Ann Arbor, Michigan	Prof. Joseph N. Payne Department of Education	Mathematics
Northern Michigan College Marquette, Michigan	Dr. Henry S. Heimonen Dept. of Geography and Earth Science	Earth Science
Minnesota		
College of St. Catherine St. Paul, Minnesota	Sister Seraphim Department of Mathematics	Mathematics
New Jersey		
Rutgers, the State University New Brunswick, New Jersey	Prof. Guido G. Weigend Department of Geography	Earth Science
New York		
Teachers College, Coulumbia Univ. New York, New York	Prof. Frederick L. Fitzpatrick Department of Science	Biology, Earth Science, Physics
Rhode Island		
University of Rhode Island Kingston, Rhode Island	Dr. Victor H. Hutchison Department of Zoology	Biology, Earth Science
South Carolina		
University of South Carolina Columbia, South Carolina	Dr. Frederick H. Giles, Jr. Department of Physics	Chemistry, Earth Science, General Science, Physics
Texas		
University of Texas Austin, Texas	Dr. W. T. Guy, Jr. Department of Mathematics	Mathematics
Virginia		
Longwood College Farmville, Virginia	Dr. Blanche C. Badger Department of Mathematics	Mathematics

Planning State Programs For Conservation Publications*

RICHARD L. WEAVER
The University of Michigan, Ann Arbor

Conservation and education leaders in most states have tried at one time or another to design one or more conservation publications for public school use.

In my recent survey of the *Nature and Extent of Leadership in Conservation Education*,[1] published in August, 1958 and covering the period of 1956 to 1958, I discovered that at least thirty states have a conservation guide of some kind for school use.

In Michigan our State Conservation Education Committee has been engaged in a publications program for three years. Therefore, we have been interested in learning what other states have been doing and in designing a program to meet our own needs which would capitalize on the strong features of publications from other states. Thus, in reporting our analysis and plans, I am hopeful that leaders in other states may utilize some of our findings in their own planning.

Statement of Philosophy

In our initial efforts in Michigan we soon discovered that we needed to agree on a particular approach to conservation education. Since our curriculum program in Michigan is geared particularly to the community school philosophy, our statement became entitled *Conservation Education in the Community School Program*.[2] Although it was printed separately and distributed quite widely, we envisioned it as the first chapter or introduction to later publications.

As a committee, we have generally felt that conservation should be woven into the total warp and woof of the educational program at whatever places it could make a contribution and help to enrich the program, particularly the physical, biological, and social sciences. We envision conservation as one of the major emphases which can help to unify the efforts of school and community leaders in training civic leaders and informed citizens. We see conservation as the cornerstone for relating the school to the community and the community to the school. Problems of community living become the focus for problem solving in the classroom. Special courses in conservation may be used as capstones but do not substitute for an integrated approach throughout all of the grades.

Similar philosophic statements concerned with a community orientation can be found in the publications of Tennessee and Florida.

Using a Team Approach

Our committee felt the need of an instrument for evaluating a school program and the faculty to see the extent of the leadership in and the facilities for conservation education. Thus, we assisted Dr. Clarence Messner in developing *A Check List of Criteria for Conservation Education*[3] as a part of a doctoral program at The University of Michigan. This was printed as an evaluation instrument for the committees' use by the Departments of Public Instruction and Conservation in October, 1958.

This set of criteria was patterned somewhat after the set used by the National Association of Biology Teachers in the Conservation Project and printed in the *Handbook for Teaching Conservation and Resource-Use*.[4]

*Presented at the NABT sessions with the AAAS, Washington, December, 1958.

[1]"The Nature and Extent of Leadership in Conservation Education in State Agencies, 1956-1958." Department of Conservation, University of Michigan, Ann Arbor, 65 pages, 1958.

[2]"Conservation Education in the Community School Program." Department of Public Instruction, Lansing, Michigan, 1955, 12 pages.

[3]Clarence Messner, "The Development and Try-Out of a Set of Criteria for the Evaluation and Improvement of a Conservation Education Program in an Elementary School." Unpublished Doctoral Dissertation, University of Michigan, 1958, 182 pages.

[4]"Handbook for Teaching Conservation and Resource-Use." National Association of Biology Teachers, 1958. 500 pages. Interstate Printers and Publishers, Inc., Danville, Illinois.

This in turn had been stimulated by the efforts of the Illinois Curriculum Committee to evaluate Illinois Schools in other areas than conservation.

The Michigan set of criteria calls for an estimate of the faculty on such things as the strengths or weaknesses of its philosophy, personnel, curriculum, and organization.

Guide to Resources

Michigan's Resource Guide called *They Need Not Vanish* has been out of print for over ten years. Only a few states have resource guides specifically prepared for school use. Florida and Louisiana each has such a guide prepared for use in the eighth or ninth grade as a text. Wyoming published an excellent reference in 1957. Arizona, Minnesota, Montana, Oregon, South Dakota, and Nevada also have guides to their states resources. Some of these include some teaching suggestions. Missouri has a series of leaflets on the various resources, first printed in 1933 and reprinted regularly and distributed in large numbers. Indiana had a similar set, but these were not reprinted after the initial small editions became exhausted.

Only one state has a significantly outstanding guide to its resources and that is Wisconsin. It is called *Natural Resources of Wisconsin*[a] and grew out of a special legislative act requesting the state agencies to prepare such a report.

After it was prepared the Legislature appropriated the money for its publication, and the Soil Conservation Committee has reprinted additional copies for its use.

We in Michigan would like to develop a similar plan as we are impressed with the cooperative nature of the project and the inclusion of such things as transportation and communication.

Teaching Guide to the Resources

A few states have tried to gear specific techniques of teaching to a guide of the resources, and this is a preferable way of proceeding. However, only a few states have had the basic resource guides. Therefore, many others have had to prepare their teaching guides as separate publications.

Many excellent teaching guides have been produced in recent years by such states as Idaho, Kansas, Maryland, Minnesota, Montana, Nevada, New Hampshire, New Mexico, New York, North Dakota, Oregon, South Carolina, South Dakota, Virginia, Vermont, West Virginia, and Wyoming.

Wisconsin's guide has been reprinted many times since its origin in 1949 and is an excellent one. A few states have come out with guides to one of the resources like the one on forests in California.

Michigan's teaching guide produced in the 1930's has long been out of print, so we have undertaken the preparation of a guide. Since our resource guide has also gone out of print we had to find a framework which would give some direction to the kinds of content which should be taught.

We were influenced by New Hampshire's attempt to organize a set of understandings or concepts for each of the resource areas. We decided to prepare such a set of statements, which we are calling understandings, and then we have tried to illustrate how each could be taught in the classroom or outdoor laboratory.

We used a ten-day writing workshop to do the writing in August, 1958, at which sixteen experienced teachers, five staff members, and eight consultants attended. The expenses were underwritten by conservation groups and industries. The workshop was cooperatively sponsored by The University of Michigan, Michigan State University, the Department of Public Instruction and the Department of Conservation, under the auspices of the Conservation Education Curriculum Committee of the State. Some preliminary work on the understandings was done in my summer conservation workshop at The University of Michigan and by some of our graduate students. The faculty members of our School of Natural Resources have also assisted at various stages.

We decided to organize the understandings into four categories, with the first two sections covering the background information from science and geography needed to understand the technical aspects of conservation. The categories were as follows:

[a] "The Natural Resources of Wisconsin." 1956, 159 pages, The Natural Resources Committee of State Agencies, Madison.

A. The characteristics, distribution and status of the resource.

B. The importance of the resource to mankind and the problems growing out of man's use.

C. The techniques of management to solve the problems created, and finally,

D. The policy and administration techniques.

We have printed the set of understandings[6] to use in our state committee work, as an evaluation instrument for teachers to use in seeing how much conservation they are including in their present teaching. They also serve as a guide for building a program. We have already improved the first edition through a recent three-day work conference of the writing committee and with the help of six consultants and our University staff members in the School of Natural Resources.

Vermont has used a somewhat similar approach in their new bulletin, and Ohio leaders are developing their new bulletin around a similar set of statements or understandings.

A "Guide to Teaching Conservation and Resource-Use in Michigan"[7] has now been published by the Department of Public Instruction in Cooperation with the Department of Conservation. Each of the *understandings* used as a framework has been illustrated with specific techniques for teaching, such as demonstrations, experiments, discussions, field trips, use of audio-visual materials, surveys, questionnaires, research and observations.

A Leadership Guide

Our Michigan committee felt the need for one more type of publication, which we have not discovered elsewhere. We developed a 55-page bulletin called a *Leadership Guide in Conservation Education*[8] to be given to people who acquired new leadership responsibilities in conservation and needed some suggestions We included such things as: suggestions for the administrators, and the teacher, for curriculum committees, in-service programs, school projects, and developing instructional materials. We also described such leadership techniques as the workshop approach, community surveys, field trips, outdoor programs, and the use of resource personnel.

Some states, such as Wisconsin have special bulletins on some of these things and others include some such information as a part of their teaching guides.

Summary and Recommendations

It is apparent that there are at least three and maybe four basic needs in each state for publications in conservation which will do the following things:

1) Describe the resources of the state, giving essential factual information for the teacher, and pointing up the basic conservation problems which are important in the state.

2) Give the teacher helpful suggestions of ways and means of making the teaching about these resources and problems, interesting and valuable. These teaching guides can be geared to a resource guide if available or to a set of basic understandings developed by competent authorities in conservation. These can best be illustrated usually by experienced teachers who have used the techniques being described.

3) Assist new people to undertake the responsibilities of leadership. Such leadership suggestions can be included in the teaching guides, but there may be considerable merit in having these in one bulletin or Leadership Guide.

4) Provide a means of evaluating a conservation education program by a checklist or set of criteria which can be used for self-analysis by teachers and administrators.

Any state which embarks on such a program of publications will probably find that a continuing committee on conservation education will be immensely helpful. There should be adequate use of the various resource agency consultants as members of the committees.

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[6] "Important Understandings for Conservation Education." Department of Public Instruction and Department of Conservation, 14 pages, 1959. Bulletin No. 424, Lansing.

[7] "Guide to Teaching Conservation and Resource-Use in Michigan," Bull. No. 425, 1960, ——— pages. Department of Public Instruction and Department of Conservation, Lansing.

[8] "Leadership Guide in Conservation Education." Bulletin No. 421, Department of Public Instruction and Department of Conservation. 55 pages, 1958, Lansing.

Various industrial groups and conservation organizations can make important contributions too.

The philosophical bases for all of these bulletins should be founded on the laws of learning, and geared as closely as possible to the learning opportunities available in the community and the state, while not overlooking the national and international implications and responsibilities.

States with Curriculum Guides, Manuals or Handbooks on Conservation Education

(Taken from pages 20-22 of the first reference cited.)

Many states have an official guide or handbook for teaching conservation in the schools. Those which have them are listed, with the title and the date of publication and number of pages. *All have been printed by the Department of Education unless otherwise indicated.*

1. *Alabama*, "Using Resources of the Community to Build a School Program." 1950, 118 pages.
2. *Arizona*, "Natural Resources of Arizona—A Guide for Improved Teaching." 1950, 180 pages, published by The Arizona Conservation Club, Inc.
3. *Arkansas*, Manuscript in preparation by means of summer workshops.
4. *California*, (a) "Conservation-Concern for Tomorrow." 1954, 173 pages. (b) "Teaching Conservation and Natural Science in the Outdoors." 1958, Department of Natural Resources. (c) "Forests of California." 1955, 147 pages, Department of Natural Resources.
5. *Florida*, "Florida—Wealth or Waste." 1954, 176 pages.
6. *Idaho*, "Conservation Handbook for Idaho Teachers." Grades 1-12, 1954, 78 pages.
7. *Illinois*, A conservation text for teachers has been prepared by personnel of the Department of Conservation and will soon be ready for distribution. It is jointly sponsored by the Department of Public Instruction.
8. *Indiana*, (a) A series of booklets on wildlife, soil, plants, minerals, and water, printed from 1946 to 1950, in limited editions and no longer available. (b) Teaching Conservation in Indiana Schools, Department of Public Instruction, Bull. No. 232. (With scope and sequence chart).
9. *Iowa*, "The Teaching of Conservation." Grades 1-8, 1949.
10. *Kansas*, Reports of Conservation Education workshops were prepared as possible state guides in limited multilith editions.
11. *Maryland*, A manuscript in mimeographed form called "Abundant Living—A Guide to Natural Resources" was prepared in three summer workshops.
    "Things To Do In Conservation." 1954, 41 pages. Now out of print, is under revision by the Division of Research and Education of the Department of Natural Resources.
12. *Michigan*, (a) "Leadership Guide to Conservation Education," Bull. 421, 1958, 60 pages. (b) "Conservation Education in Community Schools," 1955, 10 pages. (c) "Important Understandings in Conservation," Bull. 422, 1959, 14 pages. (d) "Guide to Teaching Conservation and Resource-Use." Bull. 425, 1960, —— pages.
13. *Minnesota*, "The Guide for Science and Conservation." 1951, 158 pages. Price $1.00 from Syndicate Publishing Company, 501 Park Avenue, Minneapolis, Minnesota.
    "Guide for Conservation in Grades 7-12." Published in 1956.
14. *Missouri*, A series of teacher's manuals on soil, water, forest, birds, mammals, and fish was published from 1935 to 1953 by the Missouri Conservation Commission and between 100,000 and 150,000 have been printed and distributed, with some revisions made upon reprinting.
15. *Montana*, (a) "The Conservation of Montana's Natural Resources." 1953, 64 pages. Montana Conservation Council. (b) "Suggested Activities for the Teaching of The Conservation of Natural Resources." Montana Conservation Council, 1956, 47 pages, $1.00 Reporter Printing and Supply Company, Billings, Montana.
16. *Nevada*, (a) "Conservation and Nevada." 1949, 131 pages. (Out of print). (b) "Nevada Conservation Adventure." 1954.
17. *New Hampshire*, (a) "The Wise Use of Natural Resources in New Hampshire." 81 pages, (Out of print). (b) "Learning To Use New Hampshire's Resources." A guide for secondary schools. 1956, 57 pages.
18. *New Mexico*, "Elementary Science and Conservation Handbook." 1953, 126 pages.
19. *New York*, "Using Resources Wisely." 1956, 48 pages.
20. *North Dakota*, "Conservation, Soil, and Water for the Public Schools." 1948, 127 pages.
21. *Oregon*, (a) "Conservation Education in Oregon Schools." 1955, 104 pages. (b) "Conservation Programs and Projects for Classrooms and Clubs." 1955, 33 pages by the Conservation Education Committee of Izaak Walton League of America, Oregon Division.

22. *South Carolina*, (a) "Our Land Is Our Life." 1955, 134 pages. (b) "Guide for the Teaching of Social Studies, Grades 1-12." 1956.
23. *South Dakota*, "Conservation of South Dakota's Natural Resources." 1953, 168 pages.
24. *Virginia*, "A Look at Virginia's Natural Resources." By the Virginia Resource-Use Education Council, 1955, 68 pages, reprinted in 1957.
25. *Vermont*, "Conservation Education Bulletin." Manuscript mimeographed, 1956.
26. *West Virginia*, "Living, Learning, Loving West Virginia." 1957, 82 pages.
27. *Wisconsin*, (a) The "Guide to Conservation Education in Wisconsin Schools." 1949, 96 pages, reprinted as needed. (b) "The Natural Resources of Wisconsin." 1956, 159 pages, by the Natural Resources Committee of State Agencies. (c) "Guide to Conservation Education Bibliography in Wisconsin Schools." 1958, 77 pages.
28. *Wyoming*, "Wise Use of Wyoming's Resources." 1957, 129 pages by Harold Webb. Wyoming Soil Conservation Committee, Room 308, Capitol Building, Cheyenne, Wyoming. $1.60.

BIOLOGY IN THE NEWS

Brother H. Charles, F.S.C.

THE TRUTH ABOUT THOSE REDUCING PILLS, Lester David, *Good Housekeeping*, February, 1960, pp. 50-51, 127-131.

Peddling pills, most of which are worthless and some really dangerous has become a million dollar a year racket. This is a good article to stimulate discussion of the best methods for weight control.

WONDER DRUGS: HOW MUCH CAN YOU BELIEVE? Walter Goodman, *Redbook*, February, 1960, pp. 31-33, 79-82.

The advantages and disadvantages chart contained in this article is good bulletin board material and a useful reference for your files. The article shows how indiscriminate use of these drugs can cause tragic consequences.

IS NOISE GETTING YOU DOWN? Ruth and Edward Brecher, *Saturday Evening Post*, February 6, 1960, pp. 32-33, 72.

Noise is becoming an increasingly important cause of nervousness. The article describes methods for controlling noise. It might stimulate "no noise" campaign in your school.

ORCHIDS FOR EVERYBODY, Frank J. Taylor, *Saturday Evening Post*, January 30, 1960, pp. 32-33, 88-90.

One man's efforts to popularize the use of orchids by everybody. Methods of culturing, breeding, and marketing these exotic flowers are described.

SHOULD WE KILL MORE PHEASANTS? Durward L. Allen, *Field and Stream*, February, 1960, pp. 49, 90, 128.

Too many pheasants survive the hunting season. Some experts believe 75% of all birds, male and female, should be taken each fall. This is a good article for those who want to do research in conservation.

THE ELK, Jack O'Connor, *Outdoor Life*, February, 1960, pp. 48-51, 114-110.

The life history and habits of the elk as told by a hunter who regards the animal as the "grandest and most beautiful of the deer tribe."

SHARK! Thomas Lineaweaver, *Sports Illustrated*, February 22, 1960, pp. 54-63.

Sharks are much feared by most people. This article gives much information about these large fish and gives the truth about some superstitions about the shark.

Newsletter

"Outdoor Education" is a Newsletter for the exchange of ideas on school camping and outdoor education, published by The Outdoor Education Project of the American Association for Health, Physical Education and Recreation, printed by the College of Education, Michigan State University, East Lansing, Michigan.

Boy Scouts

A special "Conservation Citizenship Award" has been presented to the Boy Scouts of America by Secretary of Agriculture Ezra Taft Benson. The United States Department of Agriculture honored the Boy Scouts for their continuing conservation programs which have made noteworthy contributions to the conservation of our Nation's natural resources.

Book Reviews

NATURE AND MAN'S FATE, Garrett Hardin, 375 pp., $6.00, Rinehart & Company, Inc., New York, 1959.

This is one of those gems that appears far too infrequently which endeavors to explain one of the complex ideas of modern science. Evolution and genetics are the chief ideas which are unfolded in a clear, lucid, and often prevocative fashion. The treatment of Darwin's work and his predecessors is unusually good. The role of Erasmus Darwin is outlined in a new and refreshing manner. Diagrams are used extensively to explain evolutionary and genetic theory. They are particularly effective in the chapter on the Wright hypothesis. Chapters on human evolution and genetics, including a good discussion on eugenics, are especially to be commended. The final chapter, "In Praise of Waste," was carried in the Saturday Evening Post. If the teacher or school librarian is looking for a clear yet provocative book on modern biology's view of evolution and genetics, this volume is highly recommended. It is the reviewer's opinion that the biology teacher should present the social studies teacher with a copy, particularly if that teacher has shown evidence of some marked ignorance of biological theory. A real gem for the better student and the teacher. P. K.

TAXONOMY OF FLOWERING PLANTS, C. L. Porter, 452 pp., W. H. Freeman and Company, Inc., San Francisco, California, 1959.

A new guide, illustrated by diagrams and black and white photographs, which classifies to family. Each family has examples cited. Introductory matter includes a history of taxonomy, herbarium techniques, collecting methods, and descriptive material of the nomenclature used in plant taxonomy. This book should be carefully examined if you are contemplating purchasing a flowering plant taxonomic key and guide. It will compare quite favorably. P. K.

THE ACADEMIC MARKETPLACE, Theodore Caplow and Reece J. McGee, x + 262 pp., $4.50, Basic Books, Inc., New York, 1958.

According to authors Caplow and McGee the American universities have bigger problems than parking for the faculty. These sociologists from the Universities of Minnesota and Texas respectively have investigated 164 vacancy-replacement situations in ten major institutions in an attempt to determine some of the conditions governing the academic labor market. Their conclusions not only make interesting reading but also raise some serious questions concerning university employment practices and policies.

The academic cloister is not as serene as it sometimes seems. The professors are no longer content with mere subsistence but now demand other "emoluments and privileges." In the "major league" universities (by definition members of the Association of American Universities) investigated in the present study, prestige, security, authority, and finally money in about that order seem to be the principal required nutrients of the intellectual tigers. Since, however, prestige is conferred by the discipline without special reference to local hierarchial rank (except in as much as institutional prestige is transferred to individuals), and authority and money are rather capriciously distributed, the interactions within departments and institutions become almost hopelessly complicated.

In this *milieu* say Caplow and McGee, a typical career begins when a young man enters as an assistant professor with his degree (Ph.D., of course) and his bright prospects of becoming a "productive scholar." His subsequent mobility and advancement are determined largely by his own initiative and his prestige (or lack of it) among the members of his particular discipline. By age forty he has either acquired status or spends his time fending off the younger men. His career may terminate in old age by retreat to the "minors" or even the "bush league" where he is rewarded for the drop in institutional prestige by higher salary and greater authority. The whole process as pictured in this study reminds one of Satchel Paige's admonition not to look back because somebody might be gaining on you.

Most readers will have difficulty in evaluating this book. It is obviously not a technical presentation, and the relatively few sociological terms are clearly defined. Yet the tables, in part, seem to have been inserted to show the reader that the authors had lots of data; and, in contrast, the text at times becomes so glib and generalized as to approach satire. Also the use of various facetious terms such as "Robber Baron," "Swivel Effect," and "Silver Cord," will not appeal to some. My personal reaction is that the style adopted is unsuitable. Instead of presenting an unbiased scientific account, the authors have succeeded in giving the impression of an attack upon the mores and behavior of a large segment of the profession. Aside from these considerations, the book is most enjoyable reading and the glimpses of something behind the facade made it worth careful study by administrators and teacher-researchers alike.

The study of such a small sample of institutions has obviously not revealed the whole structure of the academic labor market although a vast amount of information has been gathered. Anyone who attempts to act on the basis of this

incomplete picture, from either end of the operation, is apt to be abruptly and painfully readjusted. Hiring or discharging a university professor is not usually as complex as some of the cases encountered nor as casual as others:

He played the recorder. That was the reason we hired him.

(Interviewer): Because he played the recorder?

Yes, we thought that would be nice.

The coverage is so restricted that at best, this study considers only the "upper crust" of the profession where research outweighs teaching and prestige in the discipline overrides local rank and status. It applies best to the graduate schools and ignores the thousands of professors who are not in this elite group "and gladly teach."

The final chapter of recommendations seems weak because it deals primarily with symptoms rather than underlying causes. If academic men crave prestige more than security and authority more than money they will continue to interact regardless of any arbitrary reforms of the general system. The system of hiring professors would doubtless stand improvement, but it seems improbable that it is as bad as authors Caplow and McGee would lead us to believe. We will know in a very few years whether or not others have improved upon the American university hiring system as a means of encouraging innovation.

Frank N. Young
Indiana University

HANDBOOK ON BREEDING ORNAMENTAL PLANTS, 112 pp., $1.00, Brooklyn Botanic Garden, Brooklyn, New York, 1959.

Many people have the mistaken impression that crossing plants is a difficult—if not mysterious process. Actually the hybridization of many plants is a relatively simple matter which anyone can do if he knows the difference between a stamen and stigma. This little booklet describes hybridization techniques for several plants, and although it is directed primarily to the interested amateur who would like to try his hand at hy-

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bridization, some of the material may be of interest to the high school teacher and his students. The teacher will hardly find, however, that breeding plants is an ideal class project. Of all the plants discussed, the African violet is the only one which can be readily grown in the classroom, and although the pollination process takes only a few seconds, four to nine months are required for the seed capsules to reach maturity, not to mention the time needed to grow the F_1 generation. Perhaps more than as a "How-to-do-book" its chief value would lie in its use as supplementary reading for botany, particularly the brief articles on polyploidy, tree breeding, for disease resistance, and Henry Wallace's personal reminiscences on the development of hybrid corn. The last named article is marred by an editor's footnote erroneously explaining the reason for the use of the double-cross in producing hybrid corn.

The pamphlet is written by a number of specialists, and consequently it suffers a great deal from unnecessary repetition. There is also a loss of scientific accuracy in some places since the authors apparently have felt it necessary to "write down," perhaps rightly so, for their audience. A glossary is provided, but some terms needing definition, such as cultivar, are omitted. Unfortunately, hybridization techniques are not given in the article on orchids. True, as the author points out, breeding orchids holds many difficulties for the amateur, but nevertheless, no other plants quite hold the fascination for the student as do the orchids. A simple drawing showing how pollinations are made in orchids would have been a valuable addition. Attention should be called to Russell Seibert's statement in the closing paper that "we are missing the boat by not encouraging more talented students" to venture into the breeding of "that wealth of wonderful plants"—the ornamentals.

Charles B. Heiser, Jr.
Indiana University

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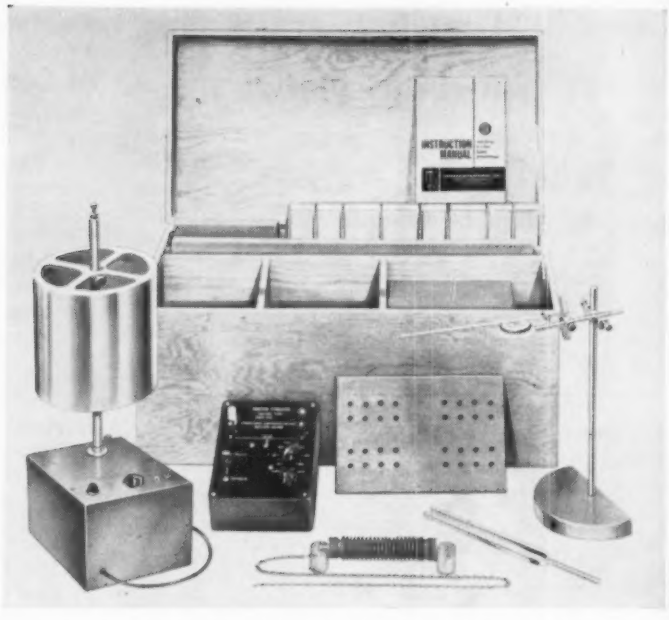

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